For the Advanced Computer User

Micro/Systems Journal™

Interrupt Borrowing With Turbo Pascal

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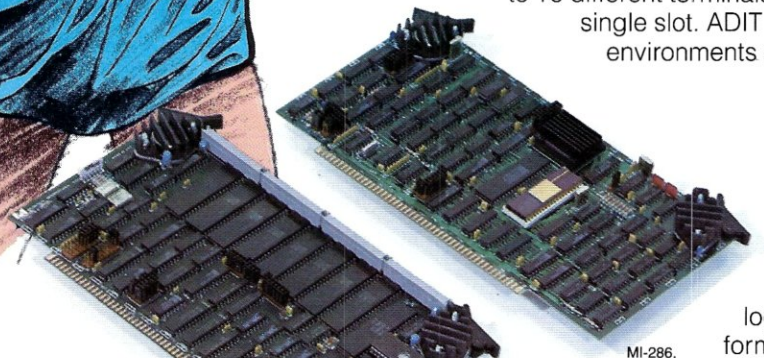

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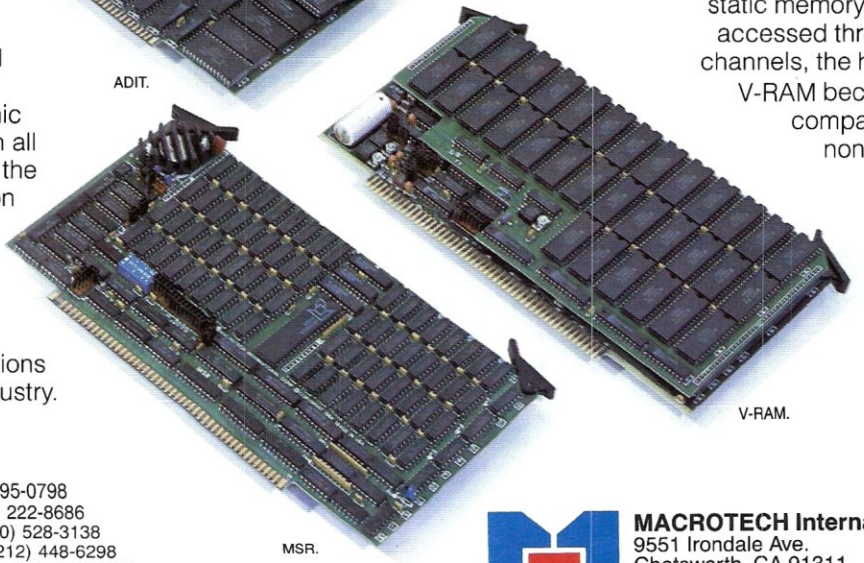

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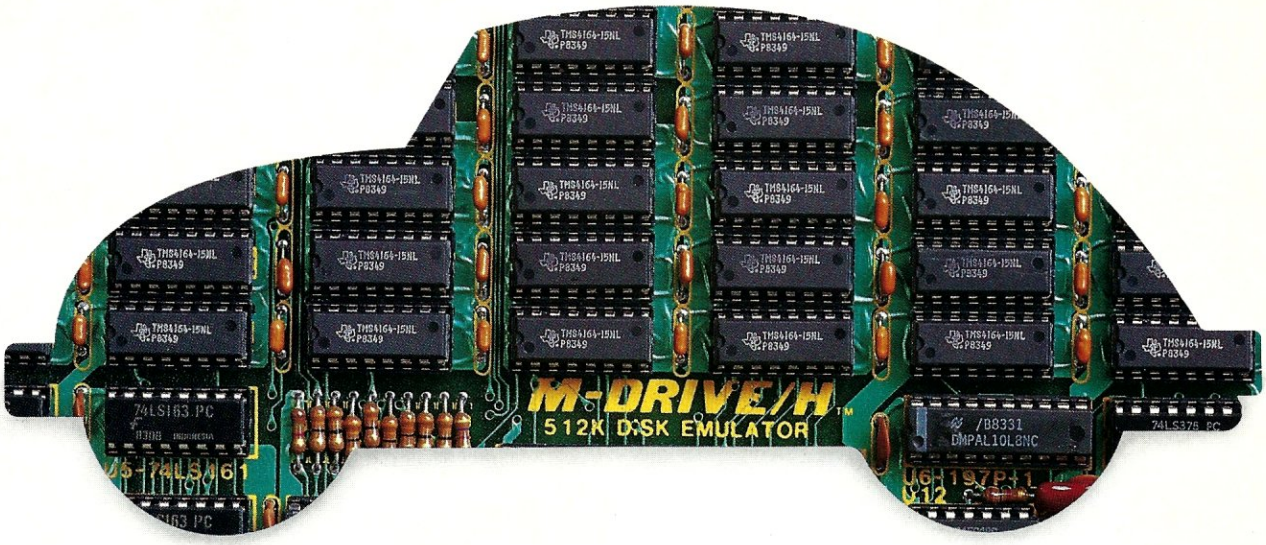

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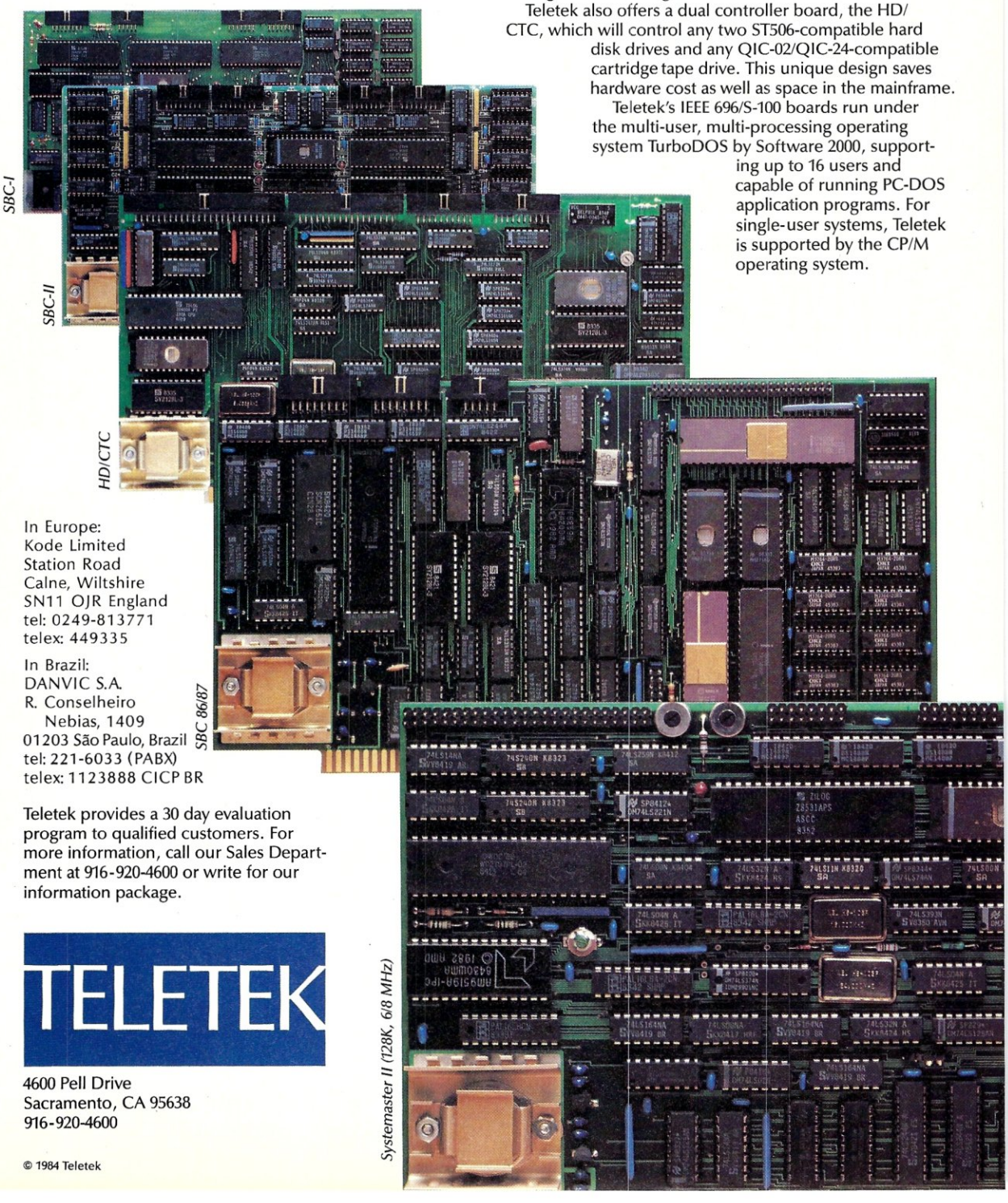

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Editor's Page

by Sol Libes

WHAT'S HAPPENING WITH DRI

Several M/SJ readers have asked me to comment on what is happening with Digital Research Inc., the developer of CP/M. These readers are primarily loyal and devoted users of CP/M-80, most dating back to the late 70's and early 80's, when CP/M-80 was a hacker's delight.

CP/M-80 was a real treat for hobbyists. Its modular architecture, simplicity of design and system generating software enabled anyone to get in there and really play with the system software. Let's face it! Those days are largely gone. Both Microsoft and DRI sell their operating systems only to OEMs. Only OEMs get the system generating software and support to implement the operating system on new hardware configurations.

DRI's and Microsoft's operating systems have facilities for writing device driver files to enhance system performance. These installable device drivers are easier to create and change than creating a new version of a BIOS. In future issues we expect to have some articles on developing device drivers for MS-DOS and Concurrent-DOS.

But let's get back to the question of what is happening at DRI.

Digital Research recently reported laying off about 40% of its staff in response to market pressure. There has also been a significant turnover in staff. DRI recently dropped a major development project for AT&T and another one for Intel (development of Unix for the 80286).

They have also reported a delay in introducting Concurrent-DOS286. This was to be their main operating system for the second half of the 80's. DRI promised that Concurrent-DOS286 would be a multitasking, multiuser system and run CP/M-86 and MS-DOS application programs in the 286's protected mode.

The rumored delay is more with Intel's 80286 chip problems than with the software. Reportedly the current version of the chip has an incompatibility (some people call them bugs) which prevents Concurrent-DOS286 from emulating MS-DOS while providing memory protection. DRI is expected to shortly release a version of Concurrent-DOS286 without these features while waiting for the bug-free 286 chip to go into production. Since the current versions of MS-DOS (3.0 and 3.1) do not provide concurrency, multiuser facilities or use the memory protection feature of the 286 chip,Microsoft or IBM have not had these problems.

Microsoft is expected to incorporate concurrency in its next version of MS-DOS. However, users who want multi-user facilities will have to go to XENIX, which at some point should also have MS-DOS emulation facilities. Microsoft's current implementation of Xenix for 286-based machines supports multi-users.

DRI FUTURE DIRECTIONS

DRI appears to be staking its future on GEM and Concurrent-DOS286. In the case of GEM, DRI has sold GEM to OEMs for a one-time licensing fee with no-royalties (quite a departure from past DRI practices). It is reported that Atari paid a $2 million flat fee for GEM. The expectation, on DRI's part, is that they will make up for the low revenue with follow-up sales of application programs for GEM.

In fact, DRI, so far, has only two real announced users of GEM, namely ATARI and ACT, neither of which, at this writing are shipping systems. DRI made a strong effort to sell GEM to IBM, Tandy, AT&T and others, so far without success. DRI must have been stunned when IBM announced TOPVIEW.

After the standard DRI OEM method of selling to IBM and PC-compatible OEMs failed, DRI decided to market GEM separately for $49.95 list (real loss-leader pricing), which is expected to net them a very slim margin of profit. All the peripheral products (e.g. Draw, Write, etc.) are being sold separately at higher prices. DRI's previous experience in the retail marketplace was disappointing and there is some question as to whether they know enough about marketing to be successful at selling to dealers and end-users versus selling to OEMs. One indication here is that DRI had originally promised several of the GEM support packages to become available in May, and are now being promised for August delivery. One thing is for sure, DRI rarely delivers promised products on their original delivery dates.

DRI's budget and personnel cuts are believed to have come primarily in the area of older product development and support (namely CP/M-80, CP/M-86 and associated products). Although these products still provide a substantial part of DRI's income (55% last year), they are expected to be a decreasing percentage of DRI's future earnings. And, DRI apparently does not see any future for these products. These products are now considered to be exclusively OEM products and DRI provides support only to OEM purchasers. Many of these products can still be purchased at retail and DRI continues to provide support via channels such as bulletin boards on CompuServe and The Source. But it is apparent that there will be no future enhancements for these products. DRI has also found that 40% of its sales are now outside the U.S.

DRI, in halting all development work on 8- and 16-bit CP/M and associated products, is concentrating all of its development efforts on 286 and 68000 versions of Concurrent-DOS and GEM. If these products are not successful DRI will be in serious trouble. After all, how much longer can CP/M's royalties subsidize the development efforts of Concurrent-DOS and GEM?

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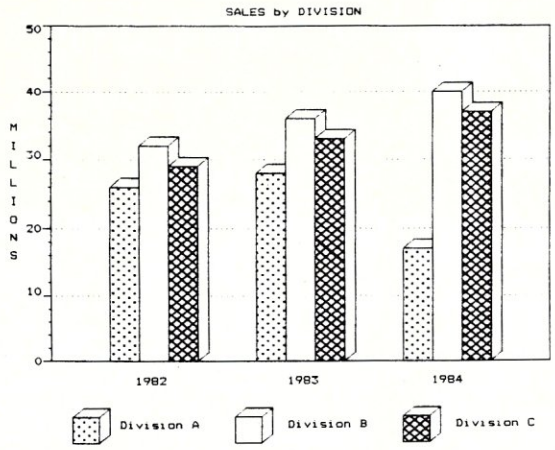

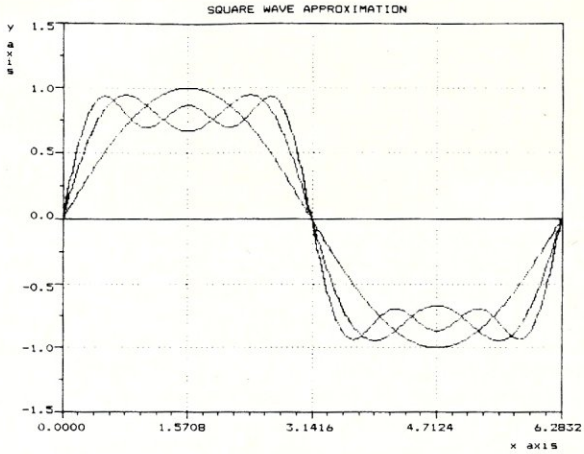

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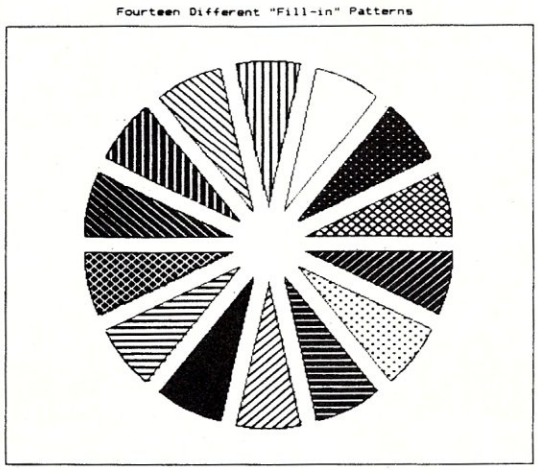

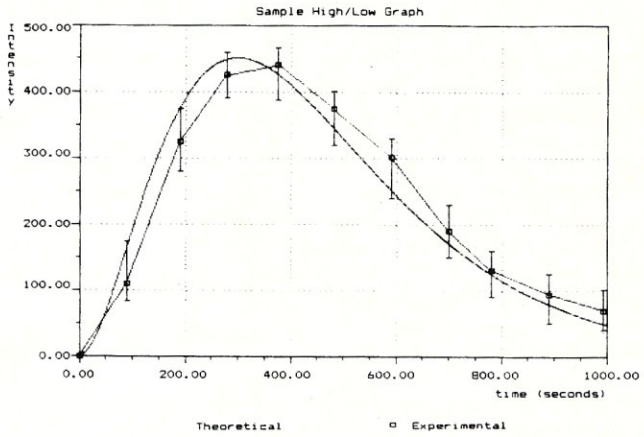

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News, Gossip Views &

by Sol Libes

DRI RETRENCHS

Digital Research has certainly changed from the days when I dealt with them regularly. All my old contacts are gone....Gary Kildall, Tom Rolander, Dennis Tillman, etc. The company is now run by corporate types concerned exclusively with GEM, Concurrent DOS and OEM business. The slump in these segments of the microcomputer market have seriously impacted DRI's revenues, forcing them to recently lay off close to 40% of its employees.

The company which had employed about 400 at its peak is now down to about 240 and there are rumors that more cuts can be expected.

Gary Kildall, who founded DRI with his ex-wife, recently resigned as Chairman. Always more interested in the technical end of the business he is reported involved with a new company, called *Activenture*, which he founded with Tom Rolander. The company is developing software for the "CD ROM", expected to be the hot new peripheral for 1986. CD ROMs are actually compact disk players similar to those used on audio and video information systems. ATARI has already announced they will introduce a $500 CD ROM, capable of holding up to 540Mbytes of data, for their new ST personal computer. And, IBM, Apple and others are known to be working on such products. Digital Equipment Corporation has already announced a CD ROM player for their Microvax 1 and 2 ($2,195) and are rumored to have licenced their technology to IBM.

SUPER 8-BIT MICRO REPORT

There are rumors that Zilog has produced first silicon versions of the Z800 super 8-bit microprocessor and furnished preliminary samples to OEMs. As I had reported last year this chip is supposed to be Z80 compatible and add extended features such as hardware multiply/divide, memory management, etc.

In the meantime Hitachi is already in production on its HD64180 8-bit microprocessor. This is also a super Z80 chip with full 8080/Z80 compatibility, hardware multiply, two serial channels, two 16-bit timers, 12 source interrupt controller, Memory Management Unit and two DMA channels that can directly address up to 512K of physical memory (bypassing the MMU). We hope to be publishing an in-depth article on the chip in the near future as well as a review of products using the chip. I know of two such products in development which we will attempt to review as soon as we can get our hands on them. One is a single board S-100 computer card from Quadram Corporation containing 512K of RAM, floppy and hard disk controllers and one parallel and two serial ports. The second product is a board designed by Steve Ciarcia which will be featured in a series of three articles starting in the September issue of Byte magazine. This latter product will be sold by Micromint.

Both products are expected to be sold with the Z-System DOS from Echelon (of ZCPR fame). Z-System is compatible with CP/M2.2 and offers such advanced features as named directories, path and redirection functions, password protection, etc. We expect to publish a review of this operating system in the not to far distant future.

We would also like to do an article on upgrading S-100 Z-80 cards to the HD64180. I would appreciate readers undertaking such a project contacting me about writing an article.

PC CLONE UPDATE

In the May/June issue of M/SJ I wrote an article on how I built a PC clone for under $1,000 with parts I bought at a computer flea market in February. I love going to computer flea markets and I always buy something there (if nothing more than printer ribbons and paper). At the last flea market, in June, I was amazed to see that prices for PC clone components were even lower than in February and that now I could put together a basic PC clone for well under $800.

The motherboard (previously $295) was now down to $195 with 16Kb of RAM ($27 more for the chips to bring it up to 256K). The power supply was now $80, disk and display controller cards $80 and $130, a DSDD half height floppy drive $70, keyboard $80, a display $65 and DOS $40. A total of $770 for a basic system. A full blown system, in a case with 10M hard disk, 640K of memory, clock/calendar, serial and parallel ports and color display could be put together for about $1,500 by some careful flea market shopping. That is well under half the street cost of an IBM PC system and about a third of the list price.

Several readers asked me to name the dealer from whom I purchased my parts. It was United Computer Resources Inc who have locations in Philadelphia PA (931 Arch Street, Phila PA 19107, 215-627-5454; speak to Alberto Chua) and in New York City (18 First Ave., NY NY 10009, 212-505-1970; speak to Peter Tien). Their prices are very low, but not rock bottom. But I found them to be reliable and stand behind what they sell.

I expect prices to drop even further this fall as there are rumors that IBM will cut prices of the PC, XT and AT by about 15% in an attempt to stimulate sales and make up for what is expected to be a lack-luster Christmas selling season. There are even rumors that IBM may start selling to mail order houses. This could mean that the street price of a basic PC would probably hit $1,000. IBM is reported to have about 200,000 PC/XT systems in warehouses that it has to move before it can switch over to the PC-II.

DON'T DUMP THOSE PC'S

IBM has a tradition of every three years (typically) introducing a new product which obsoletes a product in their line. If IBM thought that the AT would obsolete the PC and XT, and cause problems for the cloning competition, they are learning that this is not happening the way they planned. MS-DOS and the PC have, to a great extent, become generic standards and proved to be systems that are easily and economically upgradable to provide AT performance at significantly less cost. The most important upgrade is the addition of a hard disk. Many PC owners are installing 10, 20 and even larger hard disks together with tape backups and higher capacity power supplies.

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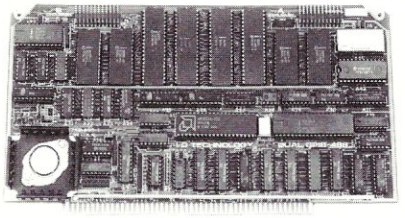

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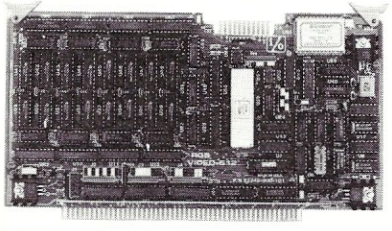

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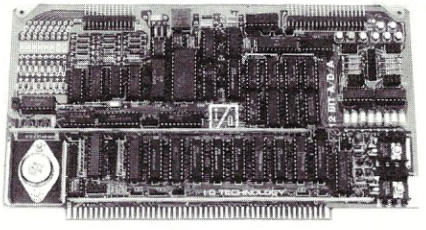

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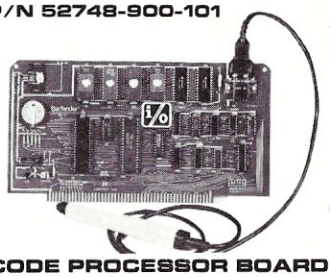

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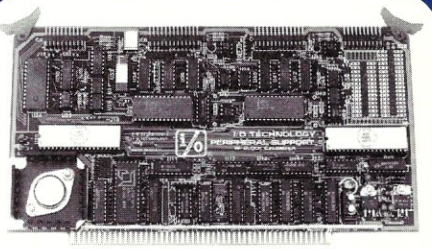

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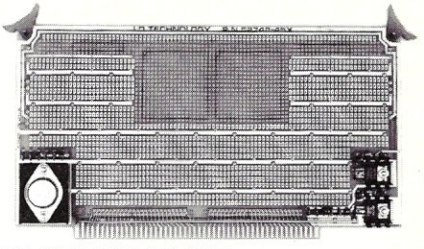

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ing in turbo processor cards, memory management systems and higher resolution displays. Many readers report that these options provide superior performance to that of the AT.

When Apple introduced the IIc they thought the IIe would fade away. Much to their suprise they learned that people wanted the upgrade-ability of the IIe. The result is that the IIe has been upgraded with hard disks, expanded memory, 16-bit CPUs, etc. to soup up its performance. Will this senario be repeated when IBM introduces the PC-II?

Further evidence of the generic status of the PC and MS-DOS is that several manufacturers of Unix systems are expected, at the upcoming Comdex show, in November, to introduce PC-compatibility. These systems are expected to allow concurrent processing. Based on the Motorola 68000, National Semiconductor 16016/32032 and Western Electric 32000 processors, they will gain this feature via 8088, 80188, 80186 or 80286 and ROM-BIOS add-on circuitry.

APPLE RUMORS

Apple Computer is expected to report a loss for the last quarter, and a loss for the previous quarter. The company is going through a top-to-bottom reorganization. Close to 40% of the employees have been laid off and three plants have been closed.

Apple is expected to change its policy of being on the cutting edge of the technology and trying to compete directly with IBM.

I expect we will see major changes in its product line. The Apple II, still their bread-and-butter product will be upgraded to an 8/16-bit machine capable of addressing up to 1Mbyte of memory. Also, I expect to see a new 3.5'' disk drive for it capable of storing nearly a 1Mbyte of data and some disk compatiblity with the Mac.

The Macintosh also,I expect,will see some major changes. Look for a new *modular Mac* with detached keyboard and display and provision for direct interfacing to the CPU's bus. I expect Apple will offer a line of modular Mac products with different displays, different keyboards, disk options, etc., a sort of hi-fi component approach to putting together a system. And of course look for performance upgrades (e.g. larger RAM capability and improved ROM operating system with built-in hard-disk and and network support.). Also, expect Apple to return to the open architecture approach which made the Apple II such a success.

32-BIT MICRO NEWS

While Intel is still struggling to get samples of its 80386 32-bit microprocessor out the door, Motorola has announced that it is now in high volume production of the 12.5Mhz version of the 68020, true 32-bitter. Further, Motorola is now sampling its 68881 32-bit math processor chip and expects limited production shortly and full production in early '86. They are also promising samples of their 68851 Peripheral Memory Management Unit next month with production in the first quarter of next year.

The Intel 80386 is expected to include the MMU circuitry on chip. Even so, it looks like Motorola and National have about a one year's lead, and possibly more, over Intel in the 32-bit area. However, it is strongly rumored that IBM will favor the 386 in its next generation of microcomputers. In fact, there are rumors that IBM is pressing Intel to get the device into production as quickly as possible. There are hints that IBM wants to announce their first 386-based system soon after the first of the year with initial shipments in the second quarter of '86.

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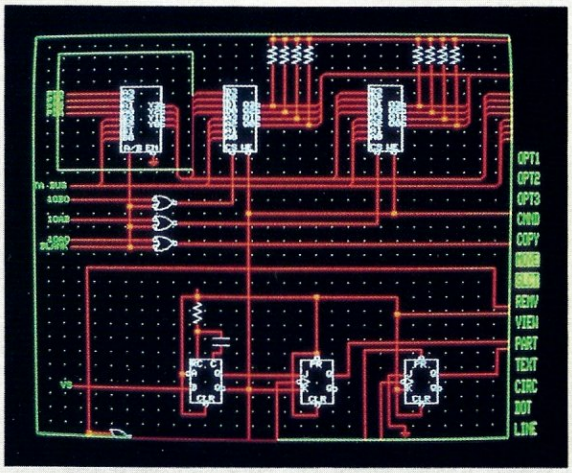

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Dear Sol:

Hurrah for the come back of Microsystems. I would be very happy if you can tell me how to get the information about the BIOS of MS-DOS. I need something like the Alternation Guide of the CP/M because I am planning to write a boot ROM for my hard disk controller. I have the Programmer's Reference Manual for the MS-DOS already, but this is not enough. I can only afford up to a few hundred for it. Can you help me? Thanks.

Wai-Shun Wong
Hong Kong

The BIOS appears, in source code form with full comments, in the IBM Technical Reference Manual for the IBM-PC. This manual was included, at no extra charge, by IBM during the first year of production and then made an optional accessory. The boot loader program has not been published, nor does IBM, Microsoft or any of the clone makers currently furnish the system generating software. I expect, soon, to publish several articles on how to implement MS-DOS on S-100, etc. systems. Please be patient.

Editor.

Dear Sol,

Readers of my COHERENT review (July/August) must be wondering about the benchmarks cited on page 77. Can a VAX take 2.4 minutes to do ten thousand getpid's? And if so, is an IBM PC more than twice as fast? Ans: nope and nope again. Here are the real timings:

DEC VAX 11/780, UNIX 4.2 BSD2.4
IBM PC AT, XENIX 3.0
AT&T UNIX PC, UNIX V 3.2
IBM PC XT, VENIX/86 2.0 .....8.4
IBM PC XT, COHERENT 2.3.3911.5

Those are CPU seconds, user + sys.

Les Hancock

Sol:

For the sake of making our publication less expensive, as well as easier to write notes on the pages, I do wish you'd change to non-glossy paper!

As to what I might like to see in the Journal, I 'm a beginner in the S-100 bus game, and can use all the help I can get. I'm building an S-100 system with dual processor CPU (Z-80H+80286), 1-meg x16-bit ram, 4 disks, and a load of I/O's. I want to know as much as I can find out about the CP/M 86 (8-16)and MS-DOS operating systems -source codes if possible- and any other enhancements that anyone knows about to improve usefulness or speed of execution of both systems. I need info on how to rewrite machine-language programs so as to eliminate machine-specific ROM calls. I'd like to see programs in both machine language and high-level languages -along with technical info on both hardware and software, special circuitry (A-D conv's, board modems, etc.) for the S-100 bus.

I've heard about public domain word-processors and spread-sheets, but I can't seem to find any through any of the sources that I've been able to con-

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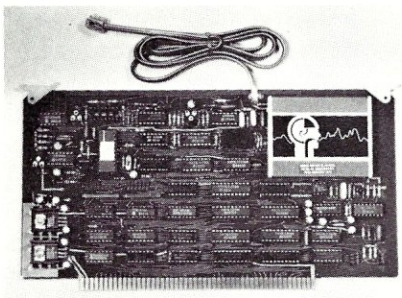

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tact so far. Are there any library lists of P.D. software available?

Anyway, Sol, I thank you for all of your hard work, and all of your help is thoroughly appreciated.

Best regards to you and yours

Tim O'Bryan
Evertt, WA

We have already published some info on MS-DOS and CP/M-86. We expect to be providing much more information. For Public Domain info check the SIG/M and PC/BLUE columns which appear in each issue of Micro/Systems Journal.

Editor.

Dear Sol:

I have a problem you or one of your readers could help me with. Ever since my office took delivery of our first Zenith Z-100 about a year ago, I've been looking for a way for it to run Z80 code on the 8-bit side. In one of the last issues of Microsystems there was a great "how to" on replacing the 8085 on Godbout's dual processsor board with a National Semiconductor NSC-800 chip. For those who don't know, the NSC-800 executes Z80 code while preserving the Intel 808x multiplexed address/data bus. I don't think I can use this "how to" on the Z-100 because its 8085 is clocked at 4.9 MHz, but the fastest NSC-800 I know about will only handle 4 MHz. I've written to National Semiconductor about a faster part, but received no reply. Has any of your readers heard of a 5 MHz NSC-800, and if so, where can I buy one?

I've considered slowing the 8-bit system clock with a new crystal, but I think this will lower the 2661B serial port baud rates too -a clearly unacceptable side effect. Can any Z100 experts confirm this and/or suggest an alternative?

It seem to me that an NSC-800 upgrade for the Z100 (like Hudson's 8087 upgrade) would be a sure fire success for the garage entrepeneur. I offer the idea to anyone willing to market it, with a request to send me the first one!

Robert G. Savage
Scott AFB IL

Dear Sol:

I was thrilled to read Cal Sondgeroth's article, "Loadable BIOS Drivers for CP/M," in the May/June issue. I had developed a similar system a few years ago on my Heath H89. May I offer to your readers the following suggested enhancements.

1. Mr. Sondgeroth's scheme is indeed useful for developing and testing BIOS modifications. But it is also useful for developing resident programs that are not necessarily device drivers. Just a few ideas are a) online help processors, b)keyboard mappers, c) foreign computer emulators (I made my H89 emulate a KayPro, d) screen dumpers, and e) I/O redirectors (capture printout and place into disk file instead).

2. Mr. Sondgeroth says that if two drivers are loaded, then the first driver is not recognized. That is not really true. Carefully coded drivers will permit more than one driver to be resident. Each driver should adhere to the following rules:

a) If it will not lead to duplication or other confusion, the driver should exit by JMPing to the original BIOS JMP vector (stored at label COLD in Mr. Sondgeroth's XBIOS module, then RET to exit. For example, a screen dumper program can CALL the original BIOS to obtain the next keyboard input. If a certain key is pressed, the screen is dumped to the printer and the BIOS is called again. Else, simply RET to pass the keyboard input on.

b) If the stack is used in the routine, then the driver should switch over to its own stack. Before exiting, of course, it must restore the stack.

3. Many CP/M programs check the first six bytes of the BDOS for the CP/M serial number. My drivers have space for the XLOAD module to store the serial number. In this way, such programs are fooled into thinking that my driver is the BDOS.

4. My warm boot routine in the driver enables interrupts just before jumping to the CCP. I'm not sure if this is really critical, but I don't think it hurts.

5. Some programs muck about with the warm boot vector in low memory, for example DDT. My warm boot routine in the driver, therefore, resets the arms boot vector. To do this, my XLOAD program stores the warm boot vector in the header of the driver where the warm boot routine will have access to it.

6. In addition to the XLOAD program, I wrote an XUNLOAD program that lets me unload BIOS drivers. Without cold booting, I can load a screen dumper program, then later unload the screen dumper if I need the memory space. Many BIOS drivers will have mucked about with interrupts, so the driver must be notified that it is being unloaded. To do this, I define a fixed address at the top of the driver as an unload entry point. While at it, I also defined an entry point that is called when the driver is loaded, and I put the name of the driver in the header so that the XLOAD and XUNLOAD programs can display a message saying which driver was loaded or unloaded. The header of my driver looks like Listing 1:

Listing 1

```
; The next four entries are filled in by XLOAD:
JXSER DS 6; CP/M serial number stored here
BDOS JMP $-$ ; Continuation jump to CP/M BDOS
DVDBOO JMP $-$ ; Warm boot jump vector from
page zero
DVDCCP JMP $-$ ; Jump to CCP

DVDNAM DB 'MyDriver' ; Name of driver
DVDLOA JMP LOAD ; Jmp to driver's load routine
    ; or just RET.
DVDUNL JMP UNLOAD ; Jmp to driver's unload
routine
; or just RET

JMP $-$
    JMP XWBOOT ; Warm boot routine for loadable
BIOS
    JMP CONST
    .; Rest of Mr. Sonderoth's XBIOS routine
    .
    .
```

The XUNLOAD module must do everything that XLOAD does, but in reverse.

Gary Cramblitt
HQ 5th SIG COMD

Dear Sol:

After your lead-in article of Volume 1/Issue 1 about bringing up CP/M Plus, I wish to state that:

CP/M 3-Plus, like 7-Up, never did work, won't work and will not in the future. It has a bug that provides incorrect data that is placed in the File Control Block (F.C.B.).

The "Bug" was documented by a CP/M Guru named Steve Russell of S.L.R. Systems. He wrote a program to demonstrate the "Bug", another to cure the bug, then translated the cure to a RSX (B.D.O.S. filter). This problem never-ever occurred with old CP/M 2.2, but it may appear under MP/M.

It is reported he shipped the documentation to Digital Research, Inc. who did their consistent thing - nothing. Luckily, he also shipped a copy to Dr. Dobbs Journal (March '85)who published it. Little notice has been given except for people who own CP/M-Plus systems.

I, for one, placed the RSX hung on a COM program in a submit routine, Profile.Sub, which is part of the boot-up routine in CP/M-Plus where it is automatically attached.

CP/M-Plus now works, even on large programs, with lots of files - never a miss. The old - "some programs won't work on CPM-3" - is no longer true. CP/M-Plus is wonderful without the annoying idiosyncrasies of the CP/M 2.2 (no warm boots when disk changes. It will even work without a system disk in the default drive).

Incidentially, some CP/M 2.2 programs work on CM/P-Plus with a RSX named CP/M 2.COM. This is a Public Domain program recently released. Now, may we have some good CP/M-Plus utilities - you Gurus.

Merrill H. Utley
Thibodaux LA

Sol:

I have an S-100 system, which I am currently trying to upgrade. There are many questions/suggestions I have that you may be able to deal with in the coming issues. I am sure that many readers would also be interested in these matters:

1. Will there be life in S-100 after the advent of 32 bit chips? I presume that by multiplexing the address and data busses, and using two unused lines as control lines (just as the expansion to 16 bit used sXTRQ* and SIXTN* as extra control lines), a 32 bit bus could be created. What about multiplexing the 16 and 32 bit lines (for both request and acknowledge) to give four states: 8 bit data/16 bit address; 16 bit data/16 bit address; 16 bit data/24 bit address; 322 bit data/32 bit address? Am I making it sound too simple, or is there another solution? Such an expansion of the S-100 definition would give S-100 an upgrade path, presumably not available to many other busses such as the STD bus and the IBM-PC bus. Is there likely to be a new IEEE standard to deal with 32 bit application?

2. What happened to the Z-800 chip? The specs for it are impressive, but is it likely to be delivered and if so what is the chance of software support after so many delays in delivery?

3. I found your book on interfacing the S-100 extremely valuable, but with a 1981 publication date, it is now a little dated. Is there any chance of a new edition? (I suspect not in view of the work in editing and publishing the new journal). Alternatively, a systematic revision of it might form the basis for a regular column in the new journal. Such a column could also discuss some of the newer design features used on S-100 and other boards and the utilization of the newer generation of memory, gating and controller chips. Undoubtedly this would be very popular amongst hardware hackers.

4. There are from time to time very good design articles in other journals, which many of your readers would not get to see. I have recently read about but have not yet seen, a design for an S-100 based hard disk controller (Ciarcia in BYTE, mid 1983). In addition, some good "cookbooks" have been published, and some magazine articles provide very readable explanations of the functioning and application of new chips. Providing a listing, from time to time, of the better articles would be a great service to hardware hackers. This is in part an alternative to suggestion 3 (above).

5. What do you see as the future of the IBM-PC and its descendents? I have heard suggestions that IBM may replace it with a new family of computers sometime soon, which may be neither hardware or software compatible with the existing products. If true, then there must be a dramatic impact on the independent software houses that have supported IBM so strongly (alas to the detriment of CP/M and other OS's), and on the market generally.

6. Has anyone built an S-100 computer that is fully IBM-PC software compatible?

7. Power supplies are a perennial problem for any amateur designer: how to calculate the size to use, how to modify a design to protect against voltage spikes, how to provide backup power, how to provide battery backup for CMOS chips when computer is switch-

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ed off, and where to use or not use supercaps as a substitute for back up batteries. A tutorial on this subject would be most helpful.

8. Finally, I am sure many readers would appreciate some "crystal ball gazing": what is the maximum useful clock speed for the S-100 bus and other busses (recent literature from Intel suggests a maximum speed of 10 MHz for the Multibus II); how much longer is the yearly doubling of the size of the memory chips likely to continue; will there be 64 bit CPU chips; will there ever be a set of chips dedicated to S-100 bus control; how much faster is modem based communication likely to become; when will optical disks become standard peripherals for microcomputers; what will the next generation of microcomputers be like?

I hope you will be able to discuss some of these questions and suggestions in the coming months, as I am sure that many of your readers would be interested as I in the answers. Again, I am delighted that you have returned to publishing!

Thanking you and best wishes,

Jeff Brownlow
Armidale, Australia

Let me respond to your questions, one at a time.

1. I expect the IEEE-696/S-100 Bus Standard committee to soon address the question of 32-bit CPUs on the bus. I suspect that the committee will come up with a scheme utilizing an expansion of the bus across the top of the board. This scheme would enable the system to operate at full throughput speed. A multiplexing scheme such as you describe would limit throughput.

I am already aware of at least two S-100 board manufacturers who intend to implement the Intel 80386 32-bit chip set on S-100 cards as soon as it becomes available. At this writing Intel is still not shipping samples. I expect that we will also see implementations of the National Semiconductor 32032 and Motorola 68020 32 bitters on the S-100 bus.

2. I understand that Zilog is shipping initial samples of the Z800 chip. If true, it means that we should see the first products using the chip by mid '86. However, note that Hitachi is already in production on their HD64180 super 8-bit Z-80 compatible microprocessor and initial systems utilizing this chip will be announced shortly.

3. I regret to say that McGraw-Hill is no longer publishing my S-100 book (actually I am the co-author with Mark Garetz). I was able to buy up the last few copies they had in stock and sold them via M/SJ. They quickly sold out. Mark and I own the rights to the book and have explored the idea of updating and reprinting it. Suffice to say that publishing the book is an expensive risk that does not appear to be justified.

4. We will try and do as you suggest.

5. If IBM is consistent with past IBM practice then it will shortly replace the PC with a system that has no hardware compatiblity and limited software compatibility with the PC. If one looks back over IBM's past practices one sees that each new computer system had a life of approximately 3 years (the PC is now 4 years old) and obsoleted its predecessor.

It appears that Boca Raton was ready to release the PC-II early this year and that the unit was software compatible with the PC-I. However, the business downturn caused IBM to accumulate several hundred thousand PC/XT systems in inventory which was quickly followed by a change in management at Boca. It appears that the new management team stopped all new product development and is currently reassessing the new PC product line. Therefore, it is hard to say what the new products will be like. I am sure that we will find out this fall and that the new systems should be shipped early next year.

6. We should be able to answer this question shortly as we are testing S-100 systems from Viasyn (CompuPro) and Lomas Data Products, which the companies contend have a very high level of PC software compatibility. There cannot be 100% compatibility without copying the PC's hardware exactly since some software packages bypass the operating system and make calls directly to hardware (primarily the display and disk controllers).

7. We will attempt to address this topic in the not too far distant future.

8. You have raised many questions here. I have addressed some of them in my "News, Views & Gossip" column and expect to continue to do more of this in future issues.

Editor.

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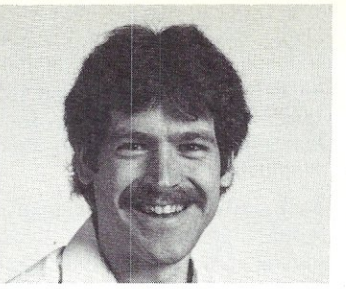
The C Forum



by Don Libes

In previous columns I discussed C programming techniques by providing examples that are educational. By that I mean that the code is readable, easily-modifiable, portable, modular, well-commented, structured, etc. I like to think of such well-written code as "elegant". Such programs should be a pleasure to read. However, not everyone writes "beautiful" code, and I would be amiss in my duties as an educator to ignore that fact.

Normally we don't consider it worthwhile to publish "ugly" or unreadable code, but there are some examples that one can actually learn by (much as I learned that a red flame was hot when I stuck my hand in it).

Thus, it is with much pleasure (and a big grin - see picture above) that I announce the *1986 Obfuscated C Code Contest*. This contest is run by Landon Noll who collects the entries and then wonders about how much thought the author must have put into destroying an otherwise good piece of code. Landon says,

The contest was motivated by reading the source code of some common Unix utilities. I was shocked at how much simple algorithms could be made cryptic, and therefore useless, by a poor choice of code style. "Could someone be proud of this code?"

The 1986 Obfuscated C Code Contest

ENTERING THE CONTEST

The 1986 contest is now open. The goal is to write the most obscure C program within the rules below:

1) Source must be 512 bytes or less.
2) Mail your entries to:
   Landon Noll
   3770 Flora Vista Ave. #705
   Santa Clara CA 95051
   or, via Usenet:
   ...!ihnp4!nsc!chongo
   or, mail them to Micro/Systems Journal and we will forward them to Landon.
3) Include at the top of the letter:
   a) Your name and address. If you want your entry to be anonymous, indicate this.
   b) A brief statement of what program should do.
   c) The machine, OS and C compiler on which it runs.
4) Enclose your source between the following lines:
   ---start of program---
   <place obfuscated source here>
   ---end of program---
5) The C program must be written in common C. That is, K&R plus common extensions.
6) The program must be of original work.
7) The program must be a complete program. (i.e., not just a fragment)
8) Entries must be received on or before June 1, 1986.

GUIDELINES

Each entry will be judged for its non-clarity. I will attempt to run each of them on a Vax 780/4.2BSD system. Don't let the lack of such a system stop you! Try to avoid operating system/machine specific code if you do not have such a system.

Extra points will be given to programs that:
a) pass lint without complaint.
b) actually do something interesting (not just exit).
c) are portable (i.e., no special calls of local features). Long variable names will be allowed as needed.

Let me point out that the guidelines for this year give more credit to lint/machine independent solutions. Thus the winner for 1984 would not be rated as high under this year's rules.

Good luck!

1984 OBFUSCATED C CODE CONTEST WINNERS

The following are the top four entries from last year's contest. Please read them carefully. If you think you understand one, you've probably glanced at it too quickly. These programs are the most bizarre examples of C code that I've ever seen. (Yes, they're much worse than the UNIX sources.) Amazingly, they all work.

They're not just good for a laugh. Each one is good for hours of study. Not only do they show you what NOT to do, but they teach you how to deal with very strange code. Lastly, you can actually learn some of the finer points of C by studying these very unusual programs.

DISHONORABLE MENTION FOR 1984:

```
int i;main(){for(;i["]<i;++i){--i;}"];read('-'-'-',i+++"hell\
o, world!\n",'/'/'/'));}read(j,i,p){write(j/p+p,i---j,i/i);}
```

AUTHOR: anonymous
COMMENT: Too embarrassed that s/he could write such trash, I guess.

THIRD PLACE FOR 1984:

```
a[900];     b;c;d=1     ;e=1;f;     g;h;O;      main(k,
l)char*     *l;{g=      atoi(*      ++l);       for(k=
0;k*k<      g;b=k       ++>>1)      ;for(h=     0;h*h<=
g;++h);     --h;c=(     (h+=g>h     *(h+1))     -1)>>1;
while(d     <=g){       ++O;for     (f=0;f<     O&&d<=g
;++f)a[     b<<5|c]     =d++,b+     =e;for(     f=0;f<O
&&d<=g;     ++f)a[b     <<5|c]=     d++,c+=     e;e= -e
;}for(c     =0;c<h;     ++c){       for(b=0     ;b<k;++
b){if(b     <k/2)a[     b<<5|c]     ^=a[(k      -(b+1)
<<5|c]^     =a[b<<5     |c]^=a[     (k-(b+1     ))<<5|c]
;printf(    a[b<<5|c    ]?"%-4d"    :"    "     ,a[b<<5
|c]);}      putchar(    '\n');}}    /*Mike      Laman*/
```

AUTHOR: Mike Laman
UUCP: {ucbvax,philabs,sdccsu3, sdcsla}!sdcsvax!laman
COMMENT: Accepts one positive argument. Try something like "cmd 37".

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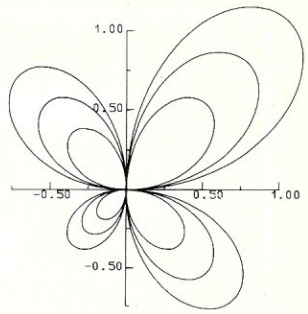

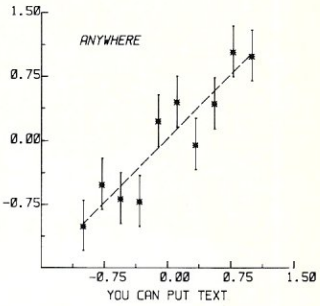

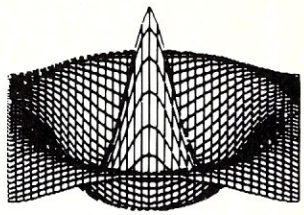

SECOND PLACE AWARD FOR 1984:

```
#define x =
#define double(a,b) int
#define char k['a']
#define union static struct

extern int floor;
double (xl, yl) b,
char x {sizeof(
    double(%s,%D)(*)())
,};
struct tag{int x0,*x0;}

*main(i, dup, signal) {
{
 for(signal=0;*k * x *__FILE__*i;) do {
  (printf(&*"'\",x); /*\n\\", (*((double(tag,u)(*)())&floor))(i)));
     goto _0;

_0: while (!(char <<x - dup)) { /*/*\*/
     union tag u x{4};
  }
}

while(b x 3, i); {
char x b,i;
  _0:if(b&&k+
  sin(signal)          / *    ((main) (b)-> x0));/*}
  ;
}

*/}}}
```

AUTHOR: Dave Decot
UUCP: hplabs!hpda!hpdsd!decot

FIRST PLACE AWARD FOR 1984:

```
/* Portable between VAX11 && PDP11 */

short main[] = {
     277, 04735, -4129, 25, 0, 477, 1019, 0xbef, 0, 12800,
     -113, 21119, 0x52d7, -1006, -7151, 0, 0x4bc, 020004,
     14880, 10541, 2056, 04010, 4548, 3044, -6716, 0x9,
     4407, 6, 5568, 1, -30460, 0, 0x9, 5570, 512, -30419,
     0x7e82, 0760, 6, 0, 4, 02400, 15, 0, 4, 1280, 4, 0,
     4, 0, 0, 0, 0x8, 0, 4, 0, ',', 0, 12, 0, 4, 0, '#',
     0, 020, 0, 4, 0, 30, 0, 026, 0, 0x6176, 120, 25712,
     'p', 072163, 'r', 29303, 29801, 'e'
};
```

AUTHORS: Sjoerd Mullender
Robbert van Renesse

ADDRESS: Vrije Universiteit, Amsterdam, the Netherlands.

UUCP: decvax!mcvax!vu44!{sjoerd, cogito}

COMMENT: Try this on your local VAX or pdp-11.

The 1985 contest was held, but timing prevented us from announcing it. The winners will be announced in a future column.

I encourage readers to write to me about topics or problems that you want to know about. I want this column to be reader driven. Write to me care of M/SJ, Box 1192, Mountainside, NJ 07092.

Don Libes is a computer scientist working in the Washington, DC area. He works on artificial intelligence in robot control systems. He is also the son of Lennie and Sol Libes.

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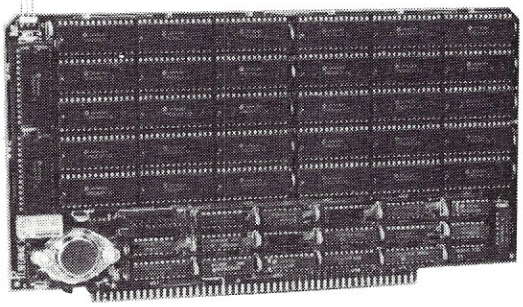

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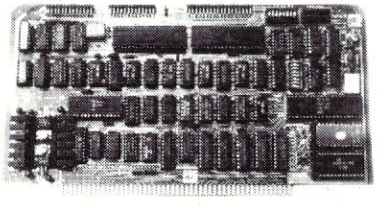

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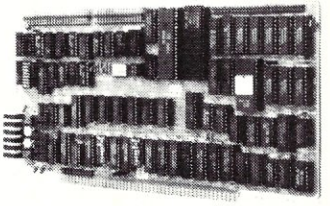

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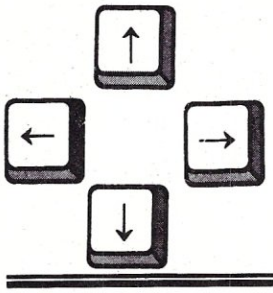
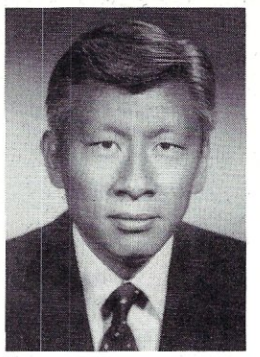


PC/Blue Report

by Hank Kee



Our forefathers, who founded this country many years ago, wrote the Constitution on which our present laws are based. The Supreme Court has the responsibility to be the ultimate governmental body to interpret these laws. They have had to interpret the intentions of what was possibly in the minds of the original authors of the Constitution. Since Thomas Jefferson and his associates are now a part of history, we will never really know the philosophy of the men who developed the framework this most important document.

Having been one of the co-founders of the SIG/M public domain library, in 1979, and its initial editor, I can state that user-supported software was never perceived as a concept. Software then was either commercial or clinically speaking public domain. My esteemed colleague, Steve Leon, has raised the issue of whether or not the public domain libraries should distribute user-supported software (*freeware*).

As the personal computer industry has evolved, so too has public domain software evolved. User supported software has now become a primary and very vital source of program donation. As the PC software industry has matured, it becomes increasingly important that this cottage industry oriented user-supported software have realistic distribution channels.

When the PC/Blue library was formed soon after the introduction of the IBM PC, it was the intention to follow the original concepts of the SIG/M library. As user-supported software became a popular art form per se, the PC/Blue library recognized the need to include these programs for distribution. The programs are for the most part very well written and documented. They tend to be application oriented.

User supported programs now include varying forms of restrictive distribution. They are also ranging to extremes in pric of requested donation. In some cases, the request for donation includes a dire threat of court action.

SHOULD "USER-SUPPORTED" SOFTWARE BE IN THE PC/BLUE LIBRARY?

This no longer represents the true spirit of software written for public distribution.

We have commercial software such as Digital Research's GEM Desktop which is available for $49.95. It includes four diskettes and a very healthy set of documentation. But we now have user support software programs "requesting" upwards of $150, and their quality is not even in the same class as Desktop.

Some user-supported software includes a restriction from commercial distribution. This is quite understandable. But others also specify exclusion from bulletin board access. The reasoning behind this is not at all clear. I would therefore like to hear reader's opinions and suggested guidelines on distribution of *user-support software*.

Is the request for "donation" unprofessional? Should there be an "upper" monetary limit to requested donations? Should there be a restriction on bulletin board access? Should vapor-ware in which the program self-destructs if conditions are not met be in the library? If a donation is requested, what kind of documentation and support should we expect the authors to supply with their programs?

Perhaps the readers can help develop guidelines for aspiring authors of user-supported software. Write to me care of Micro/Systems Journal.

Copies of the PC/Blue printed software directory can be ordered from Micro/Systems Journal, Box 1192, Mountainside NJ 07092 ($4 U.S, Canada & Mexico; $6 foreign).

Editor's Note: Hank Kee is the librarian for the PC/Blue public domain software library. He is the person who collects, assembles, and checks all the software issued by PC/Blue and then compiles and edits them into the released volumes.

THE NEW PC/BLUE RELEASES

The recent releases in the PC/Blue library includes a series of laboratory benchmarks by PC Magazine. This should help to establish some reference points for evaluation of hardware and software. As these benchmark tests are further refined, we will then have a better idea of how one product compares to another. Up until now, we have had different people rating similar products with no relationship to a common reference point.

A very significant library addition is *DeskMate*. It functions are very similar to *SideKick*. Although it is a background processor that the user can invoke to interrupt an existing process, I have found it to be very well behaved.

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Qualifying clubs who wish to distribute the PC/Blue library to its members should direct their request for being a designated distribution point to:

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The PC/Blue diskettes are individually available from the New York Amateur Computer Club at $7 domestic, and $9 foreign, per volume. A complete printed cross-referenced catalog is also available for $5. For more information direct your mail to:

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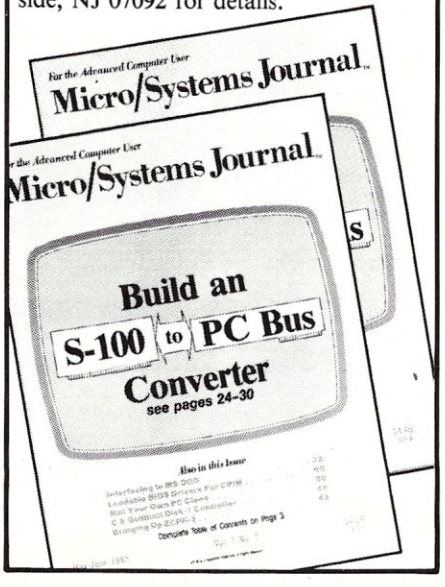

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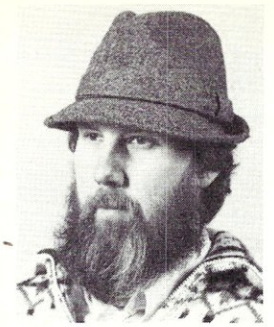
Turbo Pascal Corner



by David W. Carroll

This column features tips and techniques for using Turbo Pascal productively on MS/PC-DOS and CP/M microcomputer systems. It discusses typical problems and their solutions. Reader suggestions, comments, and questions are encouraged. Address them to: Turbo Pascal Corner, Box 699, Pine Grove CA 95665.

In the last issue, I discussed file translation and developed an ASCII/HEX file dump program. In one example, the array HEX was initialized with a series of value assignments. It would also have been possible to take advantage of the unique Turbo Pascal TYPED CONSTANT to initialize the HEX array members as variables with constant values. The code for this would be:

```
const

  hex : array[0..15] of char  =
                    '0123456789ABCDEF';
```

This is certainly a much more elegant (but non-portable) solution than the 16 assignment statements.

This time we will use the FILEDUMP program from last month to investigate the format of Turbo's compiled programs a little. Turbo Pascal's TYPED CONSTANT will come in handy in the display INSTALL program shown later in the column.

TURBO INSTALL PROGRAM

The run-time library included in a compiled Turbo Pascal program contains a copy of the current compiler display parameters. Thus, the run-time program will have the same display type as the Turbo Pascal which compiled it. In CP/M, it will be a terminal type and parameter list. In PC-DOS, it will be one of six PC display modes. The compiler display parameters are set with the TINST program, provided with the Turbo compiler. If you want to use other display parameters, to reset the parameters of a pre-compiled program, or to distribute compiled software with a customized display installation program, you are faced with a problem.

The Turbo Toolbox from Borland ($54.95) includes a "generic" install routine which will generate an install program that may be distributed to end users, but if your software supports both CP/M and MS-DOS computers, you must purchase two different versions of the Toolbox. In addition, the source to the Toolbox install programs is not provided, so customization is not possible.

In this issue we will discuss a PC-DOS INSTALL program for compiled Turbo Pascal application programs. In a future issue, we will develop a similar utility for CP/M systems.

DOS INSTALL

The Turbo Pascal compiler comes installed for the "Default display" of the IBM-PC as determined by PC-DOS, and supports either the hi-resolution monochrome display (MONO) card or the color graphics adapter (CGA) card. The default display is ok for vanila IBM systems, but if you have two monitors (MONO and COLOR) you may wish to choose the other, or if you are using a composite monochrome monitor on the CGA, most of the displayed colors will be unreadable. If you have an EGA card, or want to use some of the PCjr's special modes, you are also out of luck.

After the system is booted, the system's display mode may be changed by using the PC-DOS MODE command. Running the MODE program after every boot can be a bother, and the MODE command file is not provided in generic MS-DOS systems.

After some detective work, I discovered that the display parameters are located in the first block of every Turbo Pascal program, and they can easily be reset by changing the display information in the program's run-time library. Figure 1 is a file dump of the first few bytes of a Turbo Pascal 2.0 compiled program.

As you can see, the text description of the display settings starts at $55 (hex) bytes from the beginning of the file. (Since this is in Turbo string format, the first byte contains the string length - $13 bytes.) The byte that actually controls the computer's display mode is located at $6D bytes from the beginning of the program file (in this example it is set to $03). These locations for programs compiled under either Turbo 2.0 or Turbo 3.0 are the same.

The mode byte translates as follows:

```
$FF  = System Default display mode

$07  = Monochrome display adapter

$03  = Color Display Adapter 80x25
                          -Color monitor

$01  = Color Display Adapter 40x25
                          -Color Monitor

$02  = Color Display Adapter 80x25
                          -B&W Monitor

$00  = Color Display Adapter 40x25
                          -B&W Monitor
```

The program file is opened with the RESET command as a file of type byte. This allows it to be random accessed using the seek command. A simple module to read the installed display type in a compiled Turbo program file to a string and print it on the screen is shown in Listing 1.

The install program (listing 2) will re-install the DOS display parameter for a compiled Turbo Pascal program. It is for Turbo Pascal 2.0 and 3.0 versions for PC-DOS, but may be converted to MS-DOS versions by removing the statements labeled PC-DOS. To insure the program being changed is a compiled Turbo Pascal program, the Borland copyright notice in the run-time library is checked before the file is modified.

This program and some 300 other Turbo Pascal and public domain programs are available 24 hours a day for free downloading on the "High Sierra RBBS" system at (209)296-3534. (Note: The system was down for a while due to hard disk and telephone company problems.)

David W. Carroll is a freelance writer and computer consultant living in the Sierra Nevada foothills near Sacramento, California. He is the author of "Telecommunications with the IBM PCjr" co-published by Microtext/Prentice Hall in March 1985 and "Programming with Turbo Pascal" co-published by Microtext and McGraw Hill.

FIGURE 1 - Program File Dump

```
Address  00 01 02 03 04 05 06 07  08 09 0A 0B 0C 0D 0E 0F      ASCII TEXT

00 0000  E9 25 27 90 90 CD AB 43  6F 70 79 72 69 67 68 74   *.%'....Copyright*
00 0010  20 28 43 29 20 31 39 38  34 20 42 4F 52 4C 41 4E   * (C) 1984 BORLAN*
00 0020  44 20 49 6E 63 02 04 00  73 4F 00 00 00 00 00 00   *D Inc...sO......*
00 0030  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   *................*
00 0040  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00   *................*
00 0050  00 00 00 00 00 13 43 6F  6C 6F 72 20 64 69 73 70   *......Color disp*
00 0060  6C 61 79 20 38 30 78 32  35 00 50 19 01 03 FE F7   *lay 80x25eP.....*
00 0070  0F FF 2E 8A 27 0A E4 F9  74 0C 43 2E 8A 07 E8 0D   *....'...t.C.....*
```

LISTING 1 - Show Installed Display Mode

```
procedure type_test;
const
  type_start  = $55;

var
  indx,dat    : byte;
  display_str : string[20];

begin
  seek(infile,type_start);
  for indx := 0 to 20 do
  begin
    read(infile,dat);
    display_str[indx] := chr(dat);
  end;
  writeln;
  write('Installed display type = ');
  writeln(display_str);
end;   {procedure type_test}
```

LISTING 2

```
program turbo_install;

{TINSTALL.PAS
 Turbo Pascal Ver. 2.0
 PC-DOS Version
 Copyright 1985 by David W. Carroll
 All commercial rights reserved.
 Date: 6-22-85
 Version 5

 This program will change the start-up display
 mode of compiled Turbo Pascal 2.0 and 3.0
 PC/MS-DOS '.COM' programs.
}

const
  ASCII_offset = $30;
  logo_bytel = $07;
  type_bytel = $55;
  mode_byte  = $6D;
  type_data  : array[0..5,1..21] of char =
             (#$14'Default display mode',
             #$12'Monochrome display'#000#000,
             #$13'Color display 80x25'#000,
             #$13'Color display 40x25'#000,
             #$13'b/w   display 80x25'#000,
             #$13'b/w   display 40x25'#000);
  mode_data  : array[0..5] of byte =
             ($FF,$07,$03,$01,$02,$00);
  logo       : array[1..30] of char =
             'Copyright (C) 198X BORLAND Inc';

type
  fil      = file of byte;
  datstr   = string[20];

var
  infile              : fil;
  display_type, prog  : byte;
  quit, bad_logo      : boolean;

procedure uppercase (var Str : datstr);
var
  indx, len   : byte;

begin
  len := length(str);
  for indx := 1 to len do
    str[indx] := UpCase(str[indx])
end;   {procedure  uppercase}


procedure title;

begin
  ClrScr;
  Writeln('Turbo Pascal Install Program');
  Writeln('Copyright 1985 by David W. Carroll');
  Writeln;
  Writeln('Display Installation for Compiled Turbo Pascal
                                                Programs');
  Writeln;
  Delay(3000);
  writeln;
  writeln;
end;   {procedure title}

procedure open_file;
var
  goodfile : boolean;
  infname  : string[20];

begin
  window(1,6,80,25);     {PC-DOS}
  repeat
    ClrScr;              {PC-DOS}
    write ('Program filename  -->  ');
    readln (infname);
    writeln;
    uppercase(infname);
    if (pos('.COM',infname)=0) then
    begin
      goodfile := false;
      writeln('Must be .COM filetype!'^G);
      delay(3000);
    end
    else
    begin
      assign(infile,infname);
      {$I-} reset(infile) {$I+};
      goodfile := (IOresult = 0);
      if not goodfile then
      begin
        writeln (^G'FILE ',infname,' NOT FOUND');
        delay(3000)
      end;
    end;
  until goodfile;
end;   {procedure open_file}

procedure logo_test;
var
  indx : byte;
  test_byte : byte;

begin
  bad_logo := false;
  seek(infile,logo_bytel);
  for indx := 1 to 30 do
  begin
    read(infile,test_byte);
    if indx <> 18 then    {ignore units digit of year in logo}
      if (chr(test_byte) <> logo[indx]) then bad_logo := true;
  end;
end;   {procedure logo_test}

procedure type_test;
```

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```
var
  indx,dat    : byte;
  display_str : string[20];

begin
  seek(infile,type_byte1);
  for indx := 0 to 20 do
  begin
    read(infile,dat);
    display_str[indx] := chr(dat);
  end;
  writeln;
  write('Installed display type = ');
  writeln(display_str);
  writeln;
end;   {procedure type_test}

procedure select_display;
var
  display_indx, char_indx : byte;
  ans : char;

begin
  writeln;
  window(1,8,80,25);  {PC-DOS}
  ans := ' ';
  ClrScr;             {PC-DOS}
  type_test;
  Writeln('Choose one of the following displays:');
  Writeln;
  for display_indx := 0 to 5 do
  begin
    write('  ',display_indx:2,'.  ');
    for char_indx := 2 to 21 do
      write(type_data[display_indx,char_indx]);
    writeln;
  end;
  writeln;
  Write('Which display? (Enter no. or ^Q to exit):');
  while not (UpCase(ans) in ['0'..'5',^Q,'Q']) do
    Read(kbd,ans);
  writeln;
  writeln;
  if (UpCase(ans) in ['Q',^Q]) then
    quit := true
  else
    display_type := ord(ans) - ASCII_offset;

end;   {procedure select_display}

procedure write_data;
var
  char_indx, data_byte : byte;

begin
  seek(infile,type_byte1);
  for char_indx := 1 to 21 do
  begin
    data_byte := ord(type_data[display_type,char_indx]);
    write(infile,data_byte);
  end;
  seek(infile,mode_byte);
  write(infile,mode_data[display_type]);
  close(infile);
  writeln('Installation completed.');
end;   {procedure write_data}

procedure exit1;
begin
  close(infile);
  writeln;
  if quit then
    writeln('Program aborted.'^G)
  else
    writeln('Bad logo - not a Turbo Pascal compiled program'^G^G^G)
end;     {procedure exit1}

begin  {main module TINSTALL}
  quit := false;
  title;
  open_file;
  logo_test;
  if not bad_logo then select_display;

  if (not bad_logo) and (not quit) then
    write_data
  else
    exit1;
end.   {main module TINSTALL}
```

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In the SIG/M Public Domain

by Stephen M. Leon

I received a number of letters about my comments on "freeware." Most agreed - some didn't. What it does point up, however, is that people are aware of the 'fourth 'software market.

Personal computing software's first big market was public domain - going back to the days when a 2K program was a big. Soon there was enough software to justify trying to make it commercially selling software to users and the second market developed - commercial software. Unfortunately, with the second market came the third - unauthorized distribution of commercial software - piracy.

The most recent development, *freeware*, is certainly far superior from a social and economic standpoint than the third. I am opposed to its attempt to use the non-profit distribution structure. However, aside from their trying to free ride on the unpaid labor of the user group networks, the economic realities of this method of distribution doom it. Look at similar attempts in other markets. For example, many years ago there was a cafeteria in New York City called the Exchange Buffet. You had your lunch and then went to the cashier and told them how much you owed. The idea didn't work in cafeterias and it won't work in software marketing. Hank Kee (PC-Blue librarian) tells me that some of the freeware beggars are now asking for contributions of more than a hundred dollars. Wow!

Which brings me to the point of this discussion. Can there be piracy of public domain software? SIG/M Volume 00 and the printed catalog contain a list of authorized distributors of software. However, you can pick up any computer magazine and see ads offering to sell or rent our library. Market conditions determine the price these unauthorized distribution points can charge per volume. The SIG/M disks contain a copyright notice covering the entire scheme of the disk - much as you would copyright your collection of chocolate chip cookie recipes collected from supermarket bulletin boards. The recipes themselves are not copyrightable, but the organization of the collection as a whole is. The copyright notice was put in to counter the move of a commercial software distribution company which started distributing entire volumes as their own work product. Also, much of the SIG/M software contains copyright notices reserving all rights except non-commercial distribution.

Freeware And Public Domain Piracy

The answer to the question is therefore, just because something is on a SIG/M disk does not mean that someone can willy nilly make use of it in commercial operations. Certainly the mere reselling of the disk or a copy thereof - like the reselling of postage stamps at a premium at card shops - is perfectly all right. In fact, it promotes the wider distribution of the software and thus helps achieve the goal of SIG/M. But when it comes to the commercial operator distributing software from our releases as part of his bundle, he may well have to deal with the holder of the copyright where there is a reservation of rights. SIG/M neither asks for nor gets commercial distribution rights. Our software releases cover only non-commercial use and distribution only by other not-for-profit bona fide computer group. Any other use of the software is between the copyright owner and the user or distributor.

THE NEW SIG/M RELEASES

Academic research may well be the thread running through the latest SIG/M releases. A friend's wife was working on her thesis and decided to buy a computer for the typing. She needed two types of programs - a data base manager to keep track of her reference material and to print out the bibliography and a footnote program to handle the 300+ footnotes the thesis would have. At the same time, SIG/M got a request from a Franciscan Friar for some help with a dBase program to keep track of the Friar's reference books. These two requests produced much of the material in our latest releases.

Steve Leon is the SIG/M Disk Editor. In other words, he is the person who assembles, compiles and edits all the of the SIG/M public domain software disks. Thus, he speaks with the greatest authority as to what is going on in the SIG/M public domain software area.

Eric Mayer, a graduate student at the University of Indiana, had previously donated an earlier version of his footnoting program, but it didn't quite do everything we needed. We spoke to Eric, and lo and behold he had done an update to *Footnote* which fills in all the earlier gaps. Footnote is a formatting utility for WordStar files. It allows printing of files with page bottom footnotes with automatic numbering. It would be difficult to find an option the program does not have - from automatic page number referencing through continuation of long footnotes on following pages. It is easy to use and a must program for anyone printing a document with footnotes.

Since both the Friars and my friend had Kaypros which came bundled with dBase2, we wrote BOOKS and REFERENC (SIG/M Vol 230) to meet their needs. Both are excellent examples of how you can write a full function application which can be run by someone with no computer experience. Even if you have no need for this type of application, we suggest you study some of the coding. The string search feature that allows you to find any combination of strings in any combination of fields is a useful trick for any dBase program. Also on Volume 230 is RETRIEVE, a dBase2 program reference article retrieval system by D. A. Lathrop written for use in connection with medical research.

Volume 229, for CP/M-86 users, and especially for owners of the NEC APC, ws provided by Charlie Godot-Ceraolo of the New York NEC User Group. Also on that disk is the CP/M-86 version of GRAB, Harry Van Tassell's latest gem which enhances

Vol. 228 Disk Editor, Updated Footnote Program, Maze Game & Miscellaneous Z-80 & 8080 Programs released May 17, 1985

```
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APPEND  .COM without disturbing original files
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CFLOW   .COM    /
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LIST    .COM /
MCHASE  .COM arcade style maze chase game
MCHASE  .DOC  /
MCHASE  .HLP /
MODES   .C   MX-80 setting program
MODES   .COM /
PASSWORD.ASM requires password to use disk
PASSWORD.COM  /
PASSWORD.DOC /
SPLIT   .C   splits larger file into smaller
SPLIT   .COM ones
```

Vol. 229 CP/M 86 & NEC CP/M 86 Programs released May 17, 1985

```
APC-CALN.LBR  prints calendars - APC & MX printer
APC-DATE.LBR  screens calendars on APC
APCSERIO.LBR  interrupt driven I/O for APC
BYTYPE86.LBR  DIR sort by types to con, lst or disk
FASTVF86.LBR  cleaner, faster VFILER. CRC optional
FRAG86  .LBR  file-ext cleaner, faster, sort by files
GRAB86  .LBR  find paragraphs
SAVE0-86.LBR  emulate CP/M 2.2 SAVE 0 command
WC86    .LBR  word count, text & WS files to 8 digits
```

Vol. 230 dBaseII Databases for Scholars Articles, Books & Reference Material Databases released May 17, 1985

```
BOOKS   .LBR  database for reference books
RETRIEVE.LBR  article retrieval database
REFERENC.LBR  reference material database
```

Vol. 231 Excerpts from Micro/Systems Journal released July 19, 1985

```
CP-M+   .LBR  Bringing up CP/M-Plus
DISK1C  .LBR  C & Godbout Disk-1 Controller
EXTEND  .LBR  Assembly Language Extensions for MS BASIC
NAMES   .LBR  Logical Name Translator for CP/M 2.2
```


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FIND by pulling out whole paragraphs. The CP/M-80 version of GRAB is on Volume 228. Worth mentioning too on 228 is EDFILE, a Z-80 screen oriented disk editor much simpler to use than DU.

Volume 231 is SIG/M's first release of software extracted from Micro/Systems Journal. Software for "Assembly Language Extensions for MS BASIC", "Bringing up CP/M-Plus" and "Logical Name Translator for CP/M 2.2" (M/SJ Vol 1, No.1) and "C & the Godbout Disk-1 Controller" (M/SJ Vol 1, No.2) are on the disk. The text of all of the articles, except the MS BASIC article, is also on the disk.

SIG/M Volumes are available on 8" SS SD Disks for $6.00 each ($9.00 foreign) directly from SIG/M, Box 97, Iselin, NJ 08030. Printed catalogs are $3.00 each ($4.00 foreign). Disks in a variety of formats may be obtained through the worldwide SIG/M distribution network. The distributor list is included with the printed catalog. A disk version of the catalog (Volume 00) is available for $6.00. Many bulletin boards have the software for downloading and most new releases are available on the CP/M Sig on Compuserve.

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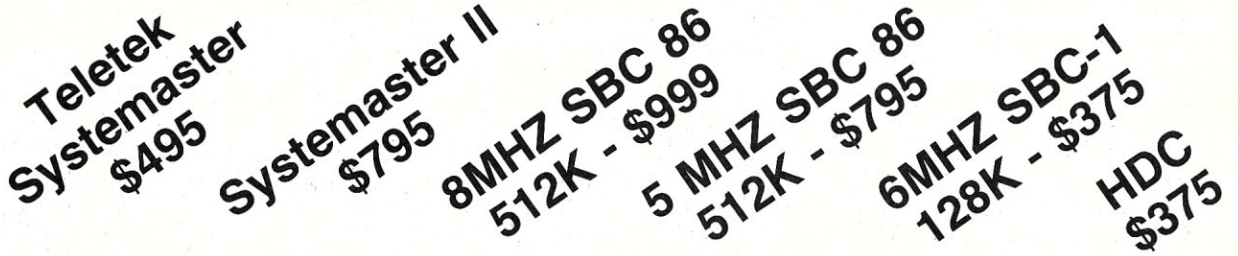

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Who Prints On The Printers ?

by Alex K.H. Soya

A Simple, Useful Utility That Illustrates How To Use Some of Concurrent DOS's Internal Structures

You are sitting in your office late in the afternoon trying to finish off a report you have been working on all day long. Finally, it is time to print the report and go home. You tell your word processor to go ahead and print out your masterpiece. You wait, but nothing happens. A feeling of panic rises inside you. Did the system crash? Does this mean you have to go and reset the system and lose all your work because you did not save it before you gave the print command? Perhaps the printer is out of paper.

You go downstairs to check the printer, but the paper level is fine. The on-line light is on. Everything checks out fine with the printer. Time to call your wife to let her know that you will be late this evening. You go over to your colleagues desk to make a phone call home. As you speak on the phone you hit the keys on your colleagues terminal out of nervousness. Was that the printer you heard ticking away in the background? You hit another key, and yes, now all becomes clear. Your colleague had control-P active on his console and went home leaving the printer locked. You hit control-P and on his console, and the printer starts printing your report, finally! Does this scenario sound familiar?

THE REASONS FOR WHOPRTS

One of the nice features of a multi-user operating system such as Concurrent CP/M (also known as Concurrent DOS or Concurrent PCDOS on an IBM) is the ability to have several printers being used simultaneously from different work stations. However, at times it can be a real problem to find out which printer is currently free.

Under the old MPM-86 system it is relatively easy to figure out which process or terminal is attached to the printer. The MPMSTAT command would show, as part of the information it displays, which process is using the printer.

Unfortunately printer related information is not easily obtained using the SYSTAT command (SYSTAT is the Concurrent CP/M equivalent to MPMSTAT). Also one cannot expect a user, who is not knowledgeable with computer systems, to be familiar with system utilities such as SYSTAT. To overcome this problem I wrote the utility WHOPRTS (WHO PRinTS). This utility makes use of some of the data structures internal to Concurrent CP/M to determine the status of all the printers on the system.

THE PROGRAM

Concurrent CP/M maintains several tables and data structures which are associated with processes and peripherals. The table of interest to WHOPRTS is the LCB (List Control Block). The LCB is actually contained within the XIOS (eXtended Input Output Subroutines) of Concurrent CP/M. The structure of the LCB is shown in figure 1. Each list device has its own LCB associated with itself. All the List Control Blocks are arranged in a sequential table (see figure 2).

The offset of the table can be found in the SYSDAT (System Data) page of Concurrent CP/M. The SYSDAT page is itself a structure containing system dependent offsets to various modules and lists internal to Concurrent CP/M. The SYSDAT table contains many other items of interest such as the number of consoles, list devices, root locations to process descriptor lists, and a multitude of other entries. The reader should refer to the Concurrent CP/M programmers guide for a detailed description of the SYSDAT table.

Digital Research was kind enough to provide a function call to return the address of the system data page. Once the location of the system data page has been obtained, it is a matter of indexing to the entries of interest. WHOPRTS requires the number of list control blocks present in the system and the location of the LCB table. The number of LCB's can be found at offset 48h, and the start of the LCB table is pointed to at offset 86h in the SYSDAT page. In Listing 1 four lines from the label VEROK the above items are obtained.

To determine if the printer associated with a particular LCB is currently busy, WHOPRTS looks at the OWNER field in the List Control Block. The owner field can have three possible states: A 0000h in the OWNER field indicates the list device is currently free; if the OWNER field

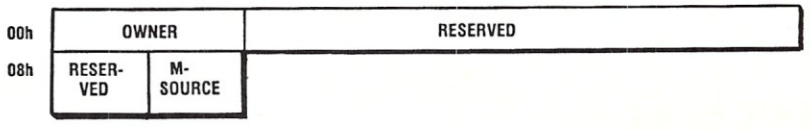
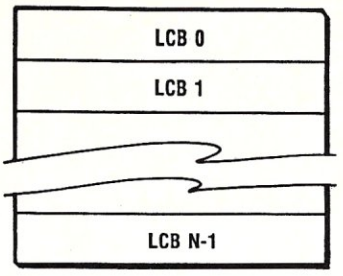


Figure 1 - The List Control Block Fields



(List Control Block for List Device 0)

(LCB for last List Device on system)

Figure 2 - The arrangement of the LCB table.

```
0A>
0A>WHOPRTS

Printer     Owner          Console

00    -     **FREE**
01    -     Cntrl-P          00
02    -     **FREE**

0A>
0A>WHOPRTS

Printer     Owner          Console

00    -     SB               01
01    -     Cntrl-P          05
02    -     **FREE**

0A>
```

Sample of WHOPRTS output.

contains an FFFFh, then the list device is attached to a console by a control-p; any other value found in the OWNER field is the address of the PD (Process Descriptor) of the process that currently owns the printer. If the printer is attached to a console by a control-P, then the MSOURCE field contains the console number of the terminal that is connected to the printer. Should the printer be owned by a process rather than a terminal, then the PD of the process must be examined to determine the console number from which the printer is being used.

The PD (Process Descriptor) contains, among other information, the name of the process and the console number the process is attached to. These items are used by WHOPRTS if the printer is not directly attached to the console by a control-P. WHOPRTS displays all the information of interest and then repeats the above actions for each printer on the system. The loop SHPRTLP in Listing 1 extracts and prints out the items of interest on the console.

ASSEMBLING WHOPRTS

WHOPRTS is written for the ASM86 assembler supplied with CCP/M by Digital Research. To assemble WHOPRTS use the commands:

```
0A>ASM86 WHOPRTS $PZSZ
0A>GENCMD WHOPRTS
```

I found WHOPRTS to be a valuable aid to determine the state of the printers on the system. WHOPRTS is in the public domain and available on several RCPM systems as well as on the Compuserve CPM SIG. If you cannot locate WHOPRTS, and don't feel like typing in listing 1, then you can call the author's Concurrent RCPM system at (305) 727-0331 and download the source or an assembled version using XMODEM.

Alex Soya has been involved with CP/M for over 8 years. He is currently a senior in computer science at Florida Institute of Technology. His interests include Operating Systems, Data Communications, System Utilities, Real Time and Scientific Programming.

```
; WHOPRTS.A86  -  Show Owners of print devices on CCPM
;
;       Alex K.H. Soya - 12/20/84
;       BOX 121, Melbourne Beach, FL. 32951
;
;       Goliath Concurrent RCPM (305) 727-0331
;
;       Compuserve [70406,1452]
;
;-----------------------------------------------------------------;
; WHOPRTS shows which printers on a Concurrent CPM system         ;
; are attached to a process or to a console by ctrl-P.            ;
; Tested under CCPM Vers. 3.1 on a CompuPro. But should work on   ;
; any system including IBM-PC under Concurrent DOS.               ;
;                                                                 ;
; This program may be freely copied and used by anyone as long as ;
; no financial/commercial gain is made. OEMs wishing to include   ;
; this program with their systems software should contact the     ;
; author for permission.                                          ;
;                                                                 ;
; 12/20/84  -  Original Version  1.0          Alex Soya           ;
;-----------------------------------------------------------------;

Version     equ     1
Revision    equ     0

cr          equ     13      ; ASCII carriage return
lf          equ     10      ; ASCII line feed

; CCPM Function calls
;
P_TERMCPM   equ     0       ; Terminate Job
C_WRITESTR  equ     9       ; Write a string to console
S_BDOSVER   equ     12      ; Return BDOS version number
S_SYSDAT    equ     154     ; Return address of system data seg.

; Some CCPM offsets
;
CMDLINE     equ     80h     ; Command line at 80h in data segment
LCBPTR      equ     86h     ; Pointer to LCB table in SYSDAT seg.
NLCB        equ     48h     ; Number of LCB's in the LCB table

; The start of the Program
;
            Cseg            ; Code segment starts here, using
                            ; SMALL model

            pushf ! pop bx  ; No interrupts during stack
            cli             ; switches under CCPM
            mov     ax,ds
            mov     ss,ax
            mov     sp, offset STACK
            push bx ! popf  ; restore FLAG register
            cmp     DS:Byte Ptr .CMDLINE, 0 ; Did he request an option,
            jz      verck                   ; nope, go check version.
            mov     cl,C_WRITESTR           ; yes, give him a comercial.
            mov     dx,Offset SECMES
            int     224

verck:      mov     cl,S_BDOSVER    ; make sure we are running CCPM
            int     224
```

```
        cmp     ah,14h          ; 8086 cpu and Concurent CP/M ?
        jz      verok
        cmp     ah,16h          ; 8086 cpu & concurent CP/M
        jz      verok           ;   w/ networking

        mov     dx, offset BADVERMES ; else tell him he is not
        mov     cl, C_WRITESTR       ; running what this is for...
        int     224

        jmp     exit            ; and get out of here.

verok:  mov     dx, offset HEADER       ; Got good version so go for it
        mov     cl, C_WRITESTR          ; Print header message
        int     224

        mov     cl,S_SYSDAT             ; Get sysdat segment location
        int     224                     ; es = sysdat segment on return
        mov     bx, es:Word Ptr .LCBPTR ; Get LCB offset
        mov     cl, es:Byte Ptr .NLCB   ; Get Number of LCBs in system

        xor     ax,ax                   ; start with printer 0
        cmp     cl,0                    ; make sure we have printers
        jg      shprtlp                 ; if No printers then
        mov     dx, offset NOPMES       ; Write " No Printers budy"
        mov     cl, C_WRITESTR
        int     224
        jmp     exit

shprtlp:                                ; lets go to work....
        push    ax                      ; Save current printer number
        push    cx                      ; Save Number of LCBs to go
        push    bx                      ; Save offset to this LCB

        call    BINASC                  ; convert to Ascii
        mov     Word Ptr PRINUM,ax      ; stuff name in string
        mov     dx, offset PRINUM       ; and print printer number
        mov     cl, C_WRITESTR
        int     224

        pop     bx                      ; restore LCB offset
        push    bx

        mov     bx, es: Word Ptr [bx]   ; get Owner offset

        cmp     bx,0                    ; If No Owner then
        jnz     chkcntp
        mov     dx, offset FREEMESS     ;    Write **FREE**
        mov     cl, C_WRITESTR
        int     224
        jmp     nextprt

chkcntp:
        cmp     bx,-1                   ; If Cntrl-P then
        jnz     findpd
        mov     dx, offset CPMESS       ;    Write ^P
        mov     cl, C_WRITESTR
        int     224
        pop     bx
        push    bx                      ;    Get LCB offset back
        mov     al,es:Byte Ptr .9[bx]
        call    BINASC                  ;    convert to Ascii
        mov     Word Ptr CONNUM,ax      ;    stuff name in string
        mov     dx, offset CONNUM       ;    and print console number
        mov     cl, C_WRITESTR
        int     224
        jmp     nextprt
                                        ; else
findpd:
        mov     cl,8                    ;    copy the name of the
        mov     si,0                    ;    process that owns the
        push    bx                      ;    printer to PDNAM field
coplp:  mov     al,es:Byte Ptr .8[bx]
        mov     Byte Ptr PDNAM[si],al
        inc     si
        inc     bx
        loopnz  coplp
        pop     bx

        push    bx
        mov     dx, offset PDNAM        ;    Write PDNAME
        mov     cl, C_WRITESTR
        int     224
        pop     bx

        mov     al, es:Byte ptr .20h[bx];    Get Console number of PD
        call    BINASC                  ;    convert to Ascii
        mov     Word Ptr CONNUM,ax      ;    stuff name in string
        mov     dx, offset CONNUM       ;    and print console number
        mov     cl, C_WRITESTR
        int     224
nextprt:
        pop     bx
        pop     cx
        pop     ax
        add     bx,10                   ;    point to next lcb
        inc     al                      ;    next printer number
        loopne  shprtlp                 ; Do all LCB's

        mov     dx, offset CRLF
        mov     cl, C_WRITESTR          ; send a CR,LF
        int     224
exit:   mov     cl,P_TERMCPM            ; and terminate
        int     224


BINASC: xor     ah,ah                   ; convert
        aam                             ; AX to ASCII
        add     ax,3030h
        xchg    ah,al                   ; put in right order
        ret


        DSEG                    ; Data segment starts here

        org 100h                ; we are using the SMALL model


BADVERMES db    '+++ Requires Concurent CP/M-86 +++',cr,lf,'$'

HEADER  db      cr,lf
        db      'Printer   Owner    Console',cr,lf,cr,lf,'$'
```

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```
NOPMES  db   '+++ No printer found on system +++',cr,lf,'$'

PRTNUM  db   'xx   -    ','$'          ; Printer Number

PDNAM   db   'xxxxxxxx   ','$'          ; Owners Name

CPMESS  db   'Cntrl-P    ','$'          ; Control-P message

FREEMESS db  '**FREE** ',cr,lf,'$'       ; Printer is FREE

CONNUM  db   'xx',cr,lf,'$'              ; Console Number

CRLF    db   cr,lf,cr,lf,'$'

SECMES  db   'WHOPRTS ',Version+'0','.',Revision+'0',' '
        db   '- (C) 1984, 1985 Alex K. Soya',cr,lf
        db   'P.O. Box 121, Melbourne Beach, FL 32951, U.S.A.',
        db   'cr,lf,cr,lf
        db   '$'

        rw   31
stack   dw   0          ; use DW so GENCMD includes stack space in
                        ; the header.

        end             ; that's all folks....time for a beer
```


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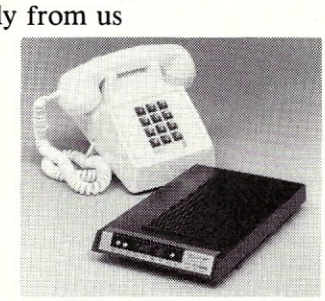

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Interrupt Borrowing with Turbo Pascal

by Stephen R. Davis

While teaching an assembler class to the local PC User Group on the subject of writing "interrupt borrowing" routines, a student asked whether it was possible to write such programs in a high-level language. I did not know the answer, but I was sufficiently intrigued by the idea to find out.

INTERRUPT BORROWING

First, we should understand what an interrupt borrower is and how it works. MS-DOS, like CP/M, does not support the computer hardware directly.

MS-DOS requires computer manufacturers to provide the interface code for their particular hardware configuration. This code is provided in a ROM BIOS (Basic Input/Output Support)installed in the machine. For this division of labor to work smoothly, MS-DOS must be able to access these support routines easily; however, since the BIOS can be written differently by different manufacturers, MS-DOS cannot predict where the individual support functions will be stored in memory. To avoid this problem, MS-DOS requires the BIOS to copy the address of each of its entry points into a specific interrupt address during the power up procedure. Figure 1 lists the BIOS functions.

When MS-DOS writes to the display screen (e.g. like a dumb terminal) it does not need to know anything about the particular screen in the machine on which it is running, nor where the screen support routines are located. It merely places 0E-hex in the AH register, the character in AL, the color in BL, and executes an interrupt-10 instruction.

In similar fashion, as part of the boot-up, MS-DOS sets up 8 interrupt functions which can be accessed by user code. These functions are at a higher level than the BIOS functions, doing more user work than the relatively crude BIOS routines. Figure 2 lists the MS-DOS interrupts. Thus it is easy to replace a BIOS or MS-DOS function with a user-provided routine. Suppose a particular BIOS function has a bug or the user wishes to use some "nonstandard" hardware which must be accessed differently than the BIOS writers envisioned. To replace the BIOS function, the user or manufacturer writes code which performs the desired function. After booting the machine, the user loads the new code into memory. He then replaces the BIOS-routine address stored in the interrupt map (Figure 3) with the address of the new code. All subsequent requests for this function from MS-DOS (or from any other software) are now diverted to the new code. This detour is invisible to the caller, as it should be (what does the caller care who performs the function as long as it gets done?). This is called interrupt "stealing".

Generally, the user runs a separate program, called an install program, which does the interrupt replacing, since replacing BIOS interrupts by hand using the debugger is clumsy and can be quite tricky. Before the introduction of installable device drivers (MS-DOS 2.11), this was the mechanism manufacturers used and is still a common practice.

It is much easier to borrow the interrupt. Instead of destroying the old address, we save it internally or in another

Interrupt Number	Function
10	Screen I/O functions:
	0- set CRT mode
	1- set cursor type
	2- set cursor position
	3- read cursor position
	4- read light pen
	5- select active page
	6- scroll page up
	7- scroll page down
	8- read char/attribute at cursor
	9- write char/attribute at cursor
	A- write char only at cursor
	B- set color palette
	C- write graphics dot
	D- read graphics dot
	E- write teletype style to screen
	F- get current video mode
11	Equipment Diagnostic Check
12	Read memory size switches
13	Diskette I/O functions:
	0- reset diskette
	1- read status
	2- read sector
	3- write sector
	4- verify sector
	5- format track
14	Serial I/O functions:
	0- init communications port
	1- send character
	2- get character
	3- read status
15	Cassette Input functions:
	0- turn motor on
	1- turn motor off
	2- read cassette
16	Keyboard Input functions:
	0- read character & key scan code
	1- check for character present
	2- read keyboard shift status
17	Printer Output functions:
	0- print character
	1- initialize printer
	2- get printer status

Figure 1 - BIOS INTERRUPTS

unused interrupt address before placing our address in the interrupt map. Such a borrower now intercepts function calls and modifies them. The request is then passed through by calling the address originally stored in the interrupt.

For example, suppose the user has an aversion to seeing lower-case letters on screen. He writes a routine which borrows the screen-output interrupt (10 hex) by saving the contents of locations 40 through 43 (see Figure 3) and placing its own address in that location. Every subsequent interrupt-10 request to output characters to the screen calls this routine. This procedure checks the character to be output and, if it is a lower-case letter, replaces it with the equivalent upper-case letter. To display the resulting character, our interrupt borrower does not need to duplicate the functions of the screen input/output code, as an interrupt "stealer" must. It merely calls the address previously saved from the screen interrupt and passes to it, the adjusted character for display. Our user is now happy in the knowledge that no application can darken his screen with a small letter, as long as our screen-interrupt sentry is on duty. (Unless an application breaks the rules and accesses the screen hardware directly — nothing is perfect.) For this all to work, the user must be able to place code in an area of memory where it will not be overwritten. MS-DOS provides just the mechanism we need in interrupt 27. It allows the caller to terminate, but STAY RESIDENT, i.e. give back control to MS-DOS, but not the memory it occupies.

This is the way most resident software such as desk organizers and RAM disks work. There are two distinct advantages borrowers have over stealers: 1) more than one borrower may be installed for any given function call, each one modifying the function in its own way and passing the results on to the next in line; and 2) a borrower is typically much simpler to write than a stealer. The borrower may rely on the original code for the bulk of the work in performing the desired function (as in our example), while the stealer must actually duplicate all of the original systems call's functions.

HIGH LEVEL LANGUAGE "BORROWERS"

To write interrupt borrowers in any particular language, the language must be able to do at least two things. It must support some type of inclusion of assembler or machine statements, either at compile or link time, and it must support executing MS-DOS and BIOS calls.

When considering which language might be suitable for writing an interrupt borrower, several candidates came to mind. BASIC was rejected as having neither capability nor convenience. C seemed up to the task, but no standard C compiler was available to the entire class (the public-domain Small C seemed a bit feeble for our purposes). Practically everyone in the class owned a copy of Turbo Pascal, so my attention turned to this language.

The Turbo Pascal MS-DOS compiler Version 2.0 from Borland Industries passed the second requirement handily with its INTR primitive for performing interrupts calls (section B.1.11.1 of the 2.0 manual). Not quite as conveniently, Turbo passed the first requirement by having an "INLINE" primitive, which allows the inclusion of assembler code in line with the object code generated by the compiler (section B.1.10).

The final encouragement came from that section B.1.11 which describes a sequence of machine code to be included at the beginning and end of interrupt routines that saves and later restores the machine registers. This code, the manual promises, will make any user-written code installable as an interrupt routine.

Being able to write interrupt borrowers in a high level language opens up new capabilities to programers not versed in assembler. Just as important, it allows users to write and get programs while working in a much shorter time frame than assembler. The eventual program will, without a doubt, be larger than the equivalent assembler program. But a quick glance at memory prices as compared with the time required to get any assembler program (no matter how trivial) to run, should reveal the economics of the situation.

Any interrupt routine written in a high-level language must be able to save the registers upon entry into the interrupt within a structure of some sort. This allows the registers to be manipulated, examined, and modified from the high level code. The language must then be able to restore the registers from the structure before returning from the interrupt to the calling program.

Unfortunately, the machine code provided by the manual did not suffice for two reasons: 1) although the registers were saved upon entry and restored before returning, they were not saved into any type of structure which could be accessed from within the program; and 2) since the machine code given did not consider the fact that any Turbo procedure will set up a stack frame upon entry, it simply would not work.

After examining exactly what a Turbo Pascal procedure does upon entry and how it stores its variables, I was able to formulate a scheme which met both requirements. The LASTCOM listing (Listing 1) demonstrates that it is possible to write such interrupt routines, although not with Turbo's example machine code.

Interrupt Number	Function
20	Terminate calling program. Return control and the memory occupied by the caller to MS-DOS.
21	Perform MS-DOS function request. Most of the MS-DOS operations available to user code are in the form of some 87 different (as of PC-DOS 2.0) function requests.
22	Terminate address. This is the address to which control passes when program terminates (this should not be called directly).
23	Control Break address. This is the address to which control passes when operator enters Control-Break or Control-C (this should not be called directly).
24	Handle critical error. Routines may perform this function call when they encounter critical or terminal error conditions.
25	Read from disk by absolute sector address.
26	Write to disk by absolute sector address.
27	Terminate calling program but leave resident. Return control to MS-DOS but not the memory occupied by the caller.

Figure 2 - MS-DOS Interrupts

EXAMPLE PROGRAM

LASTCOM is installed at boot-up by calling it with an AUTOEXEC.BAT file or from the command line. LASTCOM borrows the BIOS keyboard service interrupt (16 hex). When MS-DOS, or any other program, requests a character from the keyboard BIOS routine, LASTCOM performs the indicated request by passing the request on, but saves the response from the keyboard internally. Any sequence of up to 60 keystrokes which contains only printable characters is saved. Every time a carriage return is detected, the saved sequence is "pushed" onto a push-down stack and the top entry

cleared. In this way, the last 10 commands are saved (at least the first 60 characters of the last 10 commands). Certain considerations must be added to handle such special keys as DEL, BREAK, ESCAPE, and the function keys to insure that the commands are saved properly. To access any of these saved commands, one need only enter Alt-F10 (these two keys were chosen since they are next to each other on the IBM-PC's keyboard). LASTCOM will open a window on the screen, saving whatever is there. It then displays the first 20 characters of the last 10 commands. To reenter any of these commands, one enters the function key corresponding to that choice. Entering SHIFT-FUNCTION key will put the command chosen on the command line, but not execute it. Anything else entered will be processed normally. No matter the selection, the window on the screen is closed by replacing whatever was previously there and returning the cursor to its previous position.

IMPLEMENTATION DETAILS

Let's look at how this is done. LASTCOM consists of several procedures. When the LASTCOM program is entered, the first routine to run is the main procedure. Due to the syntax requirements of Pascal, this procedure appears last. The main procedure does not call any of the other procedures directly, but ''installs'' PROCESS_INTR by placing its address in the keyboard BIOS interrupt. The address previously at interrupt 16 is saved in one of the interrupts reserved by MS-DOS for the user; the listing uses interrupt 68 hex.

Before storing anything in the user interrupt, LASTCOM checks to make sure that it contains an address of 0. This is to protect against the possibility that some other resident program has already reserved that interrupt for its use. It also protects against accidently installing LASTCOM twice, which might be fatal. If you find that LASTCOM will not install in your system because this interrupt is in use, merely changing the value of ''USER_INT'' to any free interrupt and recompiling should fix the problem. To this end, ''USER_INT'' is clearly marked with comments in the listing.

The main procedure must also save the data segment and initialize the variables which PROCESS_INTR expects to use. Lastly, the main routine terminates with MS-DOS function 27, leaving itself and the previously defined routines, permanently resident. The amount of memory reserved by interrupt 27 can generally, in the case of an assembler program, be determined by inspection. With higher-level languages it is not as simple. In the case of LASTCOM, the minimum amount of memory was determined empirically by trying successively smaller amounts of memory until the program crashed.

When any program, including MS-DOS, requests a key from the keyboard by performing interrupt 16 hex, it unwittingly calls PROCESS_INTR. The PROCESS_INTR procedure begins with Turbo setting up its stack frame with the following instructions:

```
PUSH BP
MOV BP,SP
SUB SP,<some number>
```

In PROCESS_INTR, we are careful not to declare local variables. Thus the number to be subtracted from the stack pointer in the above code is 0 and SUB SP,0 is dropped. Upon entering the interrupt, we want to use as little of the caller's stack as possible, since we do not know how much stack space is provided.

Normally Turbo Pascal, being a ''user friendly'' language, includes a call to an internal routine immediatly after the stack-frame initialization code as shown above. This routine checks that sufficient room exists on the stack for all of the variables declared. If it is found that the stack area has ''crept down'' into data or code areas, an error message is generated. Since we must assume this subroutine will manipulate the registers without saving them, we cannot allow that subroutine to be called. The {$K-} directive, specified at the beginning of the program, keeps Turbo from including this stack-overflow check.

The first user code in PROCESS_INTR is a sequence of ''INLINE'' machine code. Turbo, as

8086 INTERRUPTS

A CPU, whatever its architecture, must always be ready to receive and act upon external interrupts (except for short periods of time when interrupts are intentionally disabled). When the interrupt arrives, the CPU must know instantly where code to handle that interrupt resides.

The 8086/88 family of microprocessors handles this problem by assigning each interrupt an address in memory. These entry points are stored in the lowest memory addresses possible. Since a complete address in the 8086/88 requires 4 bytes, each entry point occupies each subsequent 4 bytes of memory. Thus when INTERRUPT 0 occurs, control is passed to the address contained in locations 0 through 3; when INTERRUPT 1 occurs, locations 4 through 7; when INTERRUPT 2 occurs, locations 8 thru B hex, and so on. Since there are 256 (100 hex) allowed interrupt numbers in the 8086/88, the interrupt addresses take up the first 1024 (400 hex) bytes of memory. When the 8086/88 CPU acknowledges an external interrupt, the status flags, code segment, and instruction pointer registers are pushed onto the stack, disables the interrupt, clearing single step flags, and performing an intersegment jump to the entry point stored for that interrupt.

When the interrupt code is finished, executing an IRET instruction pops off the original IP and CS registers. Status flags are restored, including interrupt and single step enable, to their previous values. It is up to the interrupt code itself to save any other registers it intends to modify, and then restore them before returning. This restores the interrupted routine to its pre-interrupt state. The 8086/88 instruction set includes an ''INT <num>'' instruction, which causes the CPU to act as if an external interrupt of that number had just occurred. The IBM PC and compatibles have only one interrupt controller chip and, thus can receive only 8 different interrupts from the external world. This leaves some 248 interrupt numbers for ''internal'' interrupts.

MS-DOS expects the powerup and initialization firmware to place the screen, keyboard, and other hardware support BIOS code into particular predefined interrupts. Upon booting up, MS-DOS itself places its entry points into the locations corresponding to interrupts 20 through 27 hex (locations 80 thru 9F hex). A map of the interrupt numbers defined in MS-DOS machines appears in Figure 3. When the user code wishes to perform one of these functions, it initializes the registers to whatever input values are indicated by the function call documentation, then performing an ''INT nn'' instruction, where 'nn' is the appropriate function number. Once the function has been performed, control is returned to the instruction following the INT instruction using whatever returned values are in the registers.

This mechanism is as convenient as making a direct call to the operating-system software (if not more convenient). The INT instruction is only a few clock cycles longer than a call instruction and has the advantage of being relocatable. As new versions of MS-DOS and BIOS code are published, user code continues to function properly, even though the entry addresses of the various functions may have moved.

powerful as it is, does not allow access to the registers directly, something we must be able to do. The machine instructions save the registers into a structure that we can subsequently deal with from Turbo. Although generating this machine code is a laborious process, I reasoned that if I did it right, I would never have to do it again (and you would never have to do it at all!). Future installable programs would merely plagarize the beginning and ending hex code. To facilitate this, these code pieces have been placed into "include" files by themselves, so that may be included by several programs.

The "include" file SAVEREG (Listing 3) includes the machine code to save the registers into a structure called "REG". This machine code assumes that "REG" has been defined following the example in section B.1.11.1 of the Turbo manual rev 2.0. It further assumes that "REG" is located in the code segment. This is insured by making the structure a typed constant (refer to Chapter 13 of the Turbo manual). (It is a by product of the 8086/88 architecture that typed constants are generally stored in the code segment, although this needn't be so.) Further, the data segment must have been saved into a code segment variable called "SAVEDS" so that the procedure knows where its nonconstant variables are stored.

Initially, keystrokes are read from the keyboard by performing a call to the original BIOS keyboard code using the "INTR(USER_INT,REG)" call. When a character is returned from the BIOS call, if it is not an Alt-F10, it is saved by the procedure SAVE_KEY. SAVE_KEY tries to save the command strings the way the operator intended. For example, encountering an F5, ESCAPE, Control-C, or BREAK causes the current saved line to be flushed. Encountering a DELETE causes the previous character to be removed from the buffer. If a key is entered which does not generate an ASCII character, the entire line up to the next carriage return is not saved. This is primarily because the function keys F1 through F4 have a very context dependent meaning and, if saved, would not have the desired result when recalled.

When a carriage return is returned from the BIOS call, SAVE_KEY assumes that an entire command has been entered. If the line is not empty, it is pushed down on the command stack of the last 10 commands. As the pointer for the current command line is reset to the beginning, the oldest command in the stack is lost. If the command line is longer than 60 characters, only the first 59 and the last character are saved.

When an Alt-F10 is detected, a window is opened and the saved commands are printed, preceded by the function keys which correspond to the saved commands. LASTCOM then waits for another key to be entered. Once this key is entered, the window is closed by restoring the screen contents which have been previously saved.

If the key entered was a function key or a shift function key, the "FEEDING_CHAR" flag is set and the first character of the command string corresponding to that function key is returned to the caller. Every subsequent request for a character from the calling program sees that the "FEEDING_CHAR" flag is set and returns the next saved character from the command stack. Reaching the saved carriage return clears the "FEEDING_CHAR" flag which returns LASTCOM into the key-saving mode described above. If the key entered was not a function key, the window is closed and the key is saved in the normal way as described above.

This feeding of characters amounts to software sleight-of-hand. When LASTCOM returns a character, the caller has no way of knowing that the key did not come from the keyboard, but came rather from some internal buffer. By making use of this trick, any keyboard interrupt borrower may cause any desired key sequence to be "entered" (this is the technique used by keyboard redefinition packages such as Prokey, Superkey and the Freeware NewKey).

The registers are restored in the INLINE code contained in the RESTREG "include" file (Listing 4). The return is normally accomplished with an INLINE($CB), which is an IRET instruction. However, the INT 16 keyboard BIOS routine must return the z-flag to the caller to indicate the presence of a character. An IRET would pop the old flag off the stack, replacing whatever value the z-flag had within the procedure itself. The INLINE which appears at the end of PROCESS_INTR performs a RET FAR 2, which is identical to the IRET, except that it does not restore the flags from the stack.

LASTCOM SHORTCOMINGS

Although LASTCOM does attempt to be sophisticated enough to be useful, several improvements could be made to the program to improve its capabilities. Specifically, the presence of the carriage return is critical to a command string being saved properly. If the user is in an application which does not use carriage returns as delineators, such as WordStar, long strings may be entered without a return and with many control characters. The first command entered after exiting such an application will probably not be saved properly since the command sequence just previous, did not terminate with a return. This problem can be avoided by adding an extra carriage return after such applications as well as before entering a DOS command. This carriage return tells LASTCOM a new command line is being entered.

Further, if LASTCOM is invoked while in an application which uses function keys, arrow keys, or other non-ASCII keys, these commands will not be saved properly.

LASTCOM does, however, demonstrate that interrupt routines and interrupt borrowers need not be written in assembler. It was meant as an example to anyone desiring to write such routines using Borland Industries' excellent Turbo Pascal compiler. In fact, some quite useful programs were subsequently written by the class, using LASTCOM as a pattern. Those familiar with the public-domain, on-line Turbo help utility, THELP, have already used one of LASTCOMs progeny. Those desiring a copy of THELP may download it from the Compuserve Turbo SIG. By using LASTCOM as a learning tool, hopefully the reader is now equiped to create his or her own on-line tools.

Stephen Randy Davis is a senior systems programmer at a defense contractor in Greenville TX, where he programs various microprocessors. He is working on his masters in physics after having graduated cum laude from Rice University in Houston.

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Interrupt Number	Address	Function
		8086/88 defined
0	00 - 03	Divide by Zero
1	04 - 07	Single Step Trap
2	08 - 0B	Nonmaskable interrupt
3	0C - 0F	Breakpoint (single byte interrupt instruction)
4	10 - 13	Overflow
5	14 - 17	Print Screen
6,7	18 - 1F	Reserved
		PC Hardware Interrupts
8	20 - 23	Timer Clock
9	24 - 27	Keyboard UART
A	28 - 2B	Reserved
B	2C - 2F	COM2: Serial Port
C	30 - 33	COM1: Serial Port
D	34 - 37	Disk controller
E	38 - 3B	Diskette controller
F	3C - 3F	Parallel (printer) ports
		BIOS Functions
10	40 - 43	Screen I/O
11	44 - 47	Equipment Check
12	48 - 4B	Set Memory Size
13	4C - 4F	Disk I/O
14	50 - 53	Serial I/C
15	54 - 57	Cassette Input
16	58 - 5B	Keyboard Input
17	5C - 5F	Printer Output
18	60 - 63	ROM Resident BASIC
19	64 - 67	Power on boot strap
1A	68 - 6B	Time of day function call
1B	6C - 6F	Keyboard break
1C	70 - 73	Timer tick
1D	74 - 77	Video initialization
1E	78 - 7B	Address of diskette parameters
1F	7C - 7F	Address of graphics characters
20-27	80 - 9F	MS-DOS Functions
28-3F	A0 - FF	Reserved for MS-DOS
40-5F	100 -17F	Reserved for hardware expansion
60-7F	180 -1FF	Reserved for user programs
80-85	200 -217	Reserved for BASIC
86-F0	218 -3C3	Used by BASIC when running BASIC
F1-FF	3C4 -3FF	Not used

Figure 3 - Interrupt Map

```
(*LAST COMMAND
    written by Stephen R. Davis for Borland Turbo Pascal*)
(*$c-*)
(*$k-*)

(*this program is a "stay resident" program which allows
 operator to perform any of last 10 commands
 which he had entered by entering an AltF10 to get a
 list of them, followed by a function key F1-F10
 to select which command to reenter.  Command lines which
 begin with nonprintable keystrokes are not saved.  This
 program was written as an example of a Turbo Pascal
 "interrupt borrower" program*)

(*declare our constants*)

const
  our_char = 113;       (*this is the scan code for AltF10*)
  scan_offset = 58;     (*scan code of F1 - 1*)
  first_row = 5;        (*window size and position*)
  first_col = 5;
  numb_saved = 10;      (*number of command lines saved*)
  windowwidth = 40;
  windowlength = 12;    (*='numb_saved' + 2*)

  CR = $D;              (*ascii carriage return*)
  ESCAPE = $1B;         (*  "   escape*)
  DEL = $8;             (*  "   delete character*)
  CntrlC = $3;          (*  "   control C*)
  Unprintable = $0;     (*nonascii keys generate 0 char*)

  user_int = $68;       (*place to put borrowed interrupt--
                          may be changed to any available
                          interrupt user desires*)

  kybrd_int = $16;      (*BIOS keyboard interrupt*)
                        (*approximate size of program*)
 (*prog_size = 16000;*) (*when compiled with Turbo 2.0 --*)
   prog_size = 20000;   (*when compiled with Turbo 3.0 --*)
                        (*this much space is reserved
                          by installation procedure.
                          This number is established
                          empirically.*)

(*here the global (static type) variables*)

type
    regtype = record
                ax,bx,cx,dx,bp,si,di,ds,es,flags:integer
              end;
    halfregtype = record
                al,ah,bl,bh,cl,ch,dl,dh:byte
              end;

const                       (*put 'regs' in code segment
                             by making a typed constant*)
    regs : regtype = (ax:0;bx:0;cx:0;dx:0;bp:0;si:0;di:0;
                      ds:0;es:0;flags:0);
    feeding_char    :boolean = FALSE;
    no_cr           :boolean = FALSE;
    j               :integer = 1;
    saveds          :integer = 0;

var
    savreg          :regtype; (*define a variable for
                               register structures...*)
    halfregs        :halfregtype absolute regs; (*..and for
                                        half registers*)

    i               :integer;
    trash_line      :boolean;
    last_lines      :array [0..numb_saved] of
                     array[1..60] of integer;
    cursorpos       :integer;


(*include window manipulation software*)
(*$i window.pas*)


(* following code prints out previous n commands in
 window previously opened up*)

procedure printchoices;
var
   i,j : integer;
   outchar : byte;

begin
   for i := 2 to numb_saved+1 do        (*loop thru
                                         saved commands*)
   begin
      GoToXY(2,i);
                                (*put up function key*)
      Write('F');Write(((i-1) mod 10):1);Write(')');
      j := 1;
                                (*now saved command*)
      while ((last_lines[i-1][j] and $FF) <> CR)
            and (j <> (windowwidth-5)) do
      begin
         Write(Chr(last_lines[i-1][j] and $FF));
         j := j + 1
      end
   end
end;


(* following routine saves keystroke in
 command push down stack.  If key has some special
 meaning, routine attempts to interpret it; e.g.
 'del' deletes previous character, etc.  It can only
 interpret so much, and even then it only knows
 COMMAND.COM's rules*)

procedure save_key;
begin
    last_lines[0][j] := regs.ax;
    if (j < 60) and not trash_line then
        j := j + 1;
    case halfregs.al of     (*if that was a...*)
    DEL:                    (*...delete then...*)
        if j > 2 then       (*...delete char*)
            j := j - 2
        else
            j := 1;

    ESCAPE:                 (*...escape then...*)
        j := 1;             (*...delete line*)
```

```
    CntrlC:                 (*...Cntrl C then...*)
         j := 1;            (*...delete line*)

    Unprintable:            (*...non ascii characters...*)
         if (regs.ax = 0) or (*...if its BREAK...*)
            (regs.ax = $3F00) then  (*...or F5 then...*)
              j := 1        (*...just clear line; else...*)
         else
              trash_line := TRUE; (*...trash remainder*)
                                  (*of line to next CR*)

    CR:                     (*..if carriage return then..*)
       begin
          if trash_line then  (*if trash line flag set..*)
               j := 1;        (*...dont save line...*)
          if j > 2 then     (*..and dont save empty lines..*)
                       (*..else push command on 'stack',..*)
               for i := numb_saved downto 1 do
                    last_lines[i] := last_lines[i-1];
          for i := 1 to 60 do  (*...clear last entry,...*)
               last_lines[0][i] := $07 shl 8 + CR;
          j := 1        (*...and reset pointer*)
       end
    end;

   if j = 1 then              (*if line becomes empty...*)
      trash_line := FALSE (*...then stop trashing line*)
end;


(*this code processes interrupts to keyboard BIOS
     interrupt (16 hex)*)

procedure process_intr;
begin;
(*$i savereg.pas*)              (*save input registers*)
   if halfregs.ah = 0 then  (*if this is char request..*)
   begin
                            (*if we were in the middle of
                             spooling chars...*)
        if feeding_char then
        begin               (*...fetch next character from
                             command stack & return that*)
             regs.ax := last_lines[i][j];
             j := j + 1;
                            (*if this was last char...*)
             if (halfregs.al = CR) or (j > 60) then
             begin
                feeding_char := false; (*..turn spooling off*)
                j := 1;
                if no_cr then
                     regs.ax := $0;
                no_cr := false
             end
        end
        else
        begin     (*(we are not in middle of spooling)*)
             Intr (user_int, regs);   (*perform the BIOS call
                                       the caller asked for*)
                            (*if this wasn't "our" char...*)
             if halfregs.ah <> our_char then
                  save_key  (*...save the keystroke...*)
             else
             begin
                  savreg.ax := $0300;   (*fetch current...*)
                  savreg.bx := $0;      (*..cursor position*)
                  Intr($10,savreg);
                  cursorpos := savreg.dx;

                  openwindow;   (*open up display window*)
                  printchoices; (*now print command stack*)
                  regs.ax := $0;       (*read a character...*)
                  Intr(user_int,regs);(*...from keyboard*)

                        (*make F0 maps to 1, F1 to 2, etc.*)
                  i := halfregs.ah - scan_offset;
                  if (i > 25) and (i < 37) then
                  begin   (*shift func keys act like normal
                           func keys except no return on end*)
                       i := i - 25;
                       no_cr := true
                  end;
                  if (i > 0) and (i <= 10) then
                  begin   (*if input was a function key give
                           him  1st char of his choice...*)
                     regs.ax := last_lines[i][1];
                     if halfregs.al <> CR then
                     begin (*..and set flag to begin feeding
                            remainder of command every time
                            he asks for a char from keybd*)
                            feeding_char := true;
                            j := 2
                       end;

                  end
                  else    (*not function key--just save it*)
                       save_key;
                  closewindow;  (*put what was there back*)

                  savreg.ax := $0200; (*replace cursor*)
                  savreg.bx := $0;
                  savreg.dx := cursorpos;
                  Intr($10,savreg)
             end
        end
    end
    else                    (*he's not trying to read a char*)
        if feeding_char then (*if he's spooling chars...*)
                             (*...clear the z-flag*)
             regs.flags := regs.flags and $FFBF
        else
             Intr(user_int,regs);

(*$i restreg.pas*)          (*restore registers from 'reg'*)
    inline($CA/$02/$00)     (*RETF 02 - return to caller*)
end;


(*this section of code installs the interrupt
 routine and makes it a permanently
 resident interrupt borrower*)

(*the following dos calls are used:
 sys 25- install interrupt address
   input al = int number, ds:dx = address to install

 sys 35- get interrupt address
   input al = int number
   output es:bx = address in interrupt

 int 27- terminate and stay resident
   input dx = size of resident program
*)
begin                                   (***main***)
    (*initialize the variables which the interrupt
     service routine will use*)

    for i := 0 to numb_saved do
        for j := 1 to 60 do
             last_lines[i][j] := $07 shl 8 + CR;
    j := 1; trash_line := FALSE;
    saveds := Dseg;         (*save the data segment locally*)

    (*now install the interrupt routine*)
    savreg.ax := $35 shl 8 + user_int; (*check to make sure
                                        int not already used*)
    Intr($21,savreg);
    if savreg.es <> $00 then
    begin
        WriteLn ('Interrupt in use--cant install LASTCOM');
        Intr($20,savreg)
    end
    else
    begin
        WriteLn ('Installing LASTCOMMAND --');
        WriteLn ('     press AltF10 to select last command');
                          (*get the address that was there*)
        savreg.ax := $35 shl 8 + kybrd_int;
        Intr($21,savreg);
                           (*put the address in the
                            user interrupt*)
        savreg.ax := $25 shl 8 + user_int;
        savreg.ds := savreg.es;
        savreg.dx := savreg.bx;
        Intr($21,savreg);
                         (*install interrupt system call*)
        savreg.ax := $25 shl 8 + kybrd_int;
        savreg.ds := cseg;
                           (*put our routine address*)
        savreg.dx := Ofs(process_intr);
        Intr ($21,savreg);

        (*now terminate and stay resident*)

        savreg.dx := prog_size;
        Intr ($27,savreg)
    end
end.
```

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```
(*WINDOW.PAS*)
(* following subroutines provide further window
  capabilities to those offered by Turbo compiler.
  Note, following constants must be defined:

 first_row = first row # to place window (upper left corner)
 first_col = first col # to place window
 windowlength = number of rows long window is to be
 windowwidth = number of columns wide

 in addition structure savreg must be defined globally
 and be of register type used by turbo for system calls
*)
var
    savebuf:array [1..windowwidth] of
            array [1..windowlength] of integer;
(*read/write a char from the screen at the current
                                    cursor position*)
function GetScreenChar:integer;
begin
   savreg.ax := $0800;    (*9 -> get character/attr @ cursor*)
   savreg.bx := 0;
   Intr($10,savreg);
   GetScreenChar := savreg.ax
end;
procedure PutScreenChar(input:integer);
begin
   savreg.ax := $0900 + (input and $FF); (*a -> put
                                    char/attr @ cursor*)

   savreg.bx := input shr 8;  (*put the attrib in bl
                                    and 0 in bh*)
   savreg.cx := 1;
   Intr($10,savreg)
end;
(*open a window and save the contents away*)

procedure OpenWindow;
var
   i,j: Integer;
begin
   (*open up the window area*)

   window (first_col, first_row, first_col+windowwidth,
           first_row+windowlength);
   (*save off the data in the window*)

   for i := 1 to windowwidth do
      for j := 1 to windowlength do
      begin
         GoToXY(i,j);
         savebuf[i][j] := GetScreenChar (*get a attrib/char
                                          at the cursor*)
      end;
    (*put the frame up around the window and clear that area*)

    GotoXY(1,1);                          the window now*)
    Write(chr(218));
    for i:=2 to windowwidth-1 do Write(chr(196));
    Write(chr(191));
    for i:=2 to windowlength-1 do
    begin
       GotoXY(1, i);  Write(chr(179));
       for j := 2 to windowwidth-1 do
          Write(' ');
       GotoXY(windowwidth, i);  Write(chr(179));
    end;
    GotoXY(1, windowlength);
    Write(chr(192));
    for i:=2 to windowwidth-1 do Write(chr(196));
    Write(chr(217));
end;

(*the following procedure closes the previously
                                opened window*)
procedure closewindow;
var
   i,j:integer;

begin
   for i := 1 to windowwidth do
      for j := 1 to windowlength do
      begin
         GoToXY(i,j);
         PutScreenChar(savebuf[i][j])
      end
end;
```

```
(*SAVEREG.PAS*)

(*when invoked, this procedure saves the registers into the
  structured constant 'REGS' and restores the ds from the
  previously saved integer constant 'saveds'*)

    inline(
    $53/                    (*PUSH BX*)
    $BB/regs/               (*MOV BX,OFFSET REGS*)
    $2E/$89/$47/$00/        (*CS:MOV [BX]0,AX*)
    $58/                    (*POP AX*)
    $2E/$89/$47/$02/        (*CS:MOV [BX]2,AX*)
    $2E/$89/$4F/$04/        (*CS:MOV [BX]4,CX*)
    $2E/$89/$57/$06/        (*CS:MOV [BX]6,DX*)
    $2E/$89/$6F/$08/        (*CS:MOV [BX]8,BP*)
    $2E/$89/$77/$0A/        (*CS:MOV [BX]A,SI*)
    $2E/$89/$7F/$0C/        (*CS:MOV [BX]C,DI*)
    $2E/$8C/$5F/$0E/        (*CS:MOV [BX]E,DS*)
    $2E/$8C/$47/$10/        (*CS:MOV [BX]10,ES*)
    $9C/                    (*PUSHF*)
    $58/                    (*POP AX*)
    $2E/$89/$47/$12/        (*CS:MOV [BX]12,AX*)
    $2E/$8E/$1E/saveds      (*CS:MOV DS,SAVEDS--PUT PROPER DS*)
    );
```

```
(*RESTREG.PAS*)
(*when invoked this routine restores the registers from the
  structure constant*)

    inline(
    $BB/REGS/               (*MOV BX,OFFSET REGS*)
    $2E/$8E/$47/$10/        (*CS:MOV ES,[BX]10*)
    $2E/$8E/$5F/$0E/        (*CS:MOV DS,[BX]0E*)
    $2E/$8B/$7F/$0C/        (*CS:MOV DI,[BX]0C*)
    $2E/$8B/$77/$0A/        (*CS:MOV SI,[BX]0A*)
    $2E/$8B/$6F/$08/        (*CS:MOV BP,[BX]08*)
    $2E/$8B/$57/$06/        (*CS:MOV DX,[BX]06*)
    $2E/$8B/$4F/$04/        (*CS:MOV CX,[BX]04*)
    $2E/$8B/$47/$00/        (*CS:MOV AX,[BX]00*)
    $2E/$FF/$77/$12/        (*CS:PUSH [BX]12*)
    $9D/                    (*POPF*)
    $2E/$8B/$5F/$02/        (*CS:MOV BX,[BX]02*)
    $5D/                    (*POP BP*)  (*restore the SP*)
    $5D                     (*POP BP*)
    );
```

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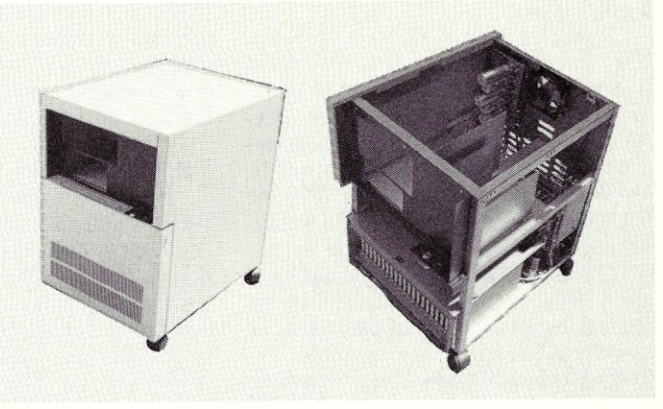

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Upgrading CompuPro I/O Boards

by R. K. GERSON

Modify CompuPro S-100 Boards For 16-Bit I/O Operation

Address decoding is supposed to be used to discriminate between different locations for either memory or I/O port activities in a computer system. The number of I/O locations or memory locations and their address bits must be known for adequate decoding. The number of address bits depends on the processor and the cycle, memory or I/O, that is used. The number of locations depends on the desired application and the address depends on where you want it, or where it has to go in your system.

Typically, 8-bit CPU's, such as the Z80, use 16-address bits for 64K distinct memory locations and 8-address bits for 256 I/O ports. This I/O range is adequate for most serial and parallel port Programmable Peripheral Interface Adapter (PPI or PIA) chips. The typical I/O block size for most LSI I/O chips such as the 8251, 8255, or Z80 PIO's and SIO's is one to four unique addresses. 16-bit CPUs come in a variety of packages for memory addressing. For example, the 8086 CPU has 20 address bits to decode 1 MB of virtual memory. And it uses 16 address bits for a total of 64 K distinct I/O locations. That's quite a lot of I/O and most of you are not likely to use it all, but it is conceivable that you may want to use more than 256 I/O locations.

For more information on S-100 I/O decoding for 8-bit I/O space, refer to Dave Hardy's article in Microsystems (1983), the Garetz and Libes book, Interfacing to the S-100 Bus (1981), and Micro Cornucopia (1985). I have not seen any articles in the popular computer journals concerning I/O addressing for 16-bit I/O space. This is a trifle odd since all of the more powerful processors appearing in microcomputers today, such as the 68000, 16032 and 8086/80286, have at least 16-bit I/O capability.

THE APPLICATION

It just so happens I needed about 100 I/O address locations to program an LSI DMA chip containing almost as many registers. This chip is the heart of a data acquisition transfer system I developed for medical X-ray imaging at the Ontario Cancer Institute. This work is being done on a CompuPro S-100 8086/87 computer with CP/M-86. By the way, CompuPro, is a trademark of the Bill Godbout Electronics Corporation, which now calls itself the Vaisyn Corporation.

The I/O address of the peripheral board that I designed resides high in the I/O space of the 8086 to avoid conflict with other system utilities. The board select address decoding circuitry was set at 1100 to 12FF hex. The LSI DMA chip has 81 internal registers, some 8 and some 16-bits wide. However, all of the registers are located on even word addresses. Some registers are operationally 24 bits wide, being composed of a lower 16-bit and a higher 8-bit register. Other I/O addresses are required to control various functions in the operation of the LSI DMA controller. The LSI chip was, therefore, addressed within the range of 1200 to 12FF hex on the prototype board.

THE CONFLICTS

Problems arose with some of CompuPro's boards and manifested themselves in strange ways. There were some mysterious changes in control and data words that were sent out to program the mighty multi-register LSI chip. This altered the intended operation of the device begetting sheer chaos. The problem, once identified, was trivial, but it should be documented so that others will be able to correct it.

CompuPro has not completely decoded the upper I/O address bits, A8 to A15, on some of their S-100 I/O boards. The boards that are affected in my system are the DISK 1, INTERFACER 4, and the SYSTEM SUPPORT. Andrew Bender (1983) reviewed the CompuPro 86/87 system and these boards, and pointed out a few other minor problems.

These CompuPro boards all required a few additional gates to prevent their 8-bit I/O space from being mapped repeatedly in the 16-bit I/O space. It is entirely possible that CompuPro is not at fault, perhaps originally intending these boards to be used only with 8-bit CPU boards or in systems where the number of I/O locations does not exceed 256 ports. Unfortunately, if the boards are not decoded completely for 16-bit I/O space, you will have problems; for example, the SYSTEM SUPPORT has

16 ports that will be mapped into each 256 block of the 64K I/O space. That is 256 times!

MODIFYING COMPUPRO S-100 BOARDS

Figure 1 shows the additional decoding circuitry required to prevent a conflict when other locations in 16-bit I/O space are used. The additional gates are used to determine that the values of the address bits A8 to A15 are all zero. The output of the additional logic is inserted into the CompuPro address or board select circuitry. Now it will be impossible for a CompuPro I/O board to be selected unless its specific 16-bit I/O address has been given. Figures 2, 3, and 4 are adapted from the CompuPro manuals. These diagrams show the insertion points of the additional decoding from Figure 1. Only the Interfacer 4 board requires the circuit in Figure 1b as well as the circuit in Figure 1a. The additions to the DISK 1 and SYSTEM SUPPORT boards make use of an available select line on a 74LS138 IC on these boards.

No changes have been made to the I/O strobe qualifying circuits on the CompuPro boards, since they work just fine. The additional integrated circuits were simply glued upside down at convenient locations on the CompuPro boards and leads were wire wrapped directly to their pins and soldered to the various locations on the boards as indicated in the diagrams. Take some care to mark pin 1 on the bottom of the additional chips before glueing them down.

DISK 1 & SYSTEM SUPPORT BOARDS

Two 74LS32s were used to decode A8 to A15 on all of the boards. The output of these gates becomes the new input to select the 74LS138 decoder on the board, U11 on the DISK 1, and U19 on the SYSTEM SUPPORT board. On the DISK 1, pin 4 of U11 was originally tied to pin 5 of U11. For this modification, U11 was pulled out of its socket, pin 4 was bent away from the IC and the 74LS32 output (location 'A' in Figure 1a) was wire wrapped to pin 4. Then the chip was returned to its socket. For the SYSTEM SUPPORT, pin 4 of U19 was originally tied to ground. IC U19 was removed and pin 4 was bent away from the IC and connected to the output of the 74LS32 (location 'A' in Figure 1a).

INTERFACER 4

Addresses A8 to A15 were decoded using two additional 74LS32s (Figure 1a). The output was inverted and ANDed with the result of the decoding from addresses A0 to A7 at ASEL (U41 pin 3) on the board (Figure 1b). Instead of using two IC chips to accomplish this, a one package solution was to use several gates of a 74LS00. The address decoding output was inverted with one 74LS00 NAND gate, while two 74LS00 NAND gates were used to make the required AND gate. A wire soldered to pin 3 of U41 was used as one input to the AND gate (Figure 1 b). To complete the address decoding path, pins 2 and 4 of IC U23 were pulled out of the socket, and the output of the 74LS00 NAND gate was connected to pins 2 and 4 of the IC U23.

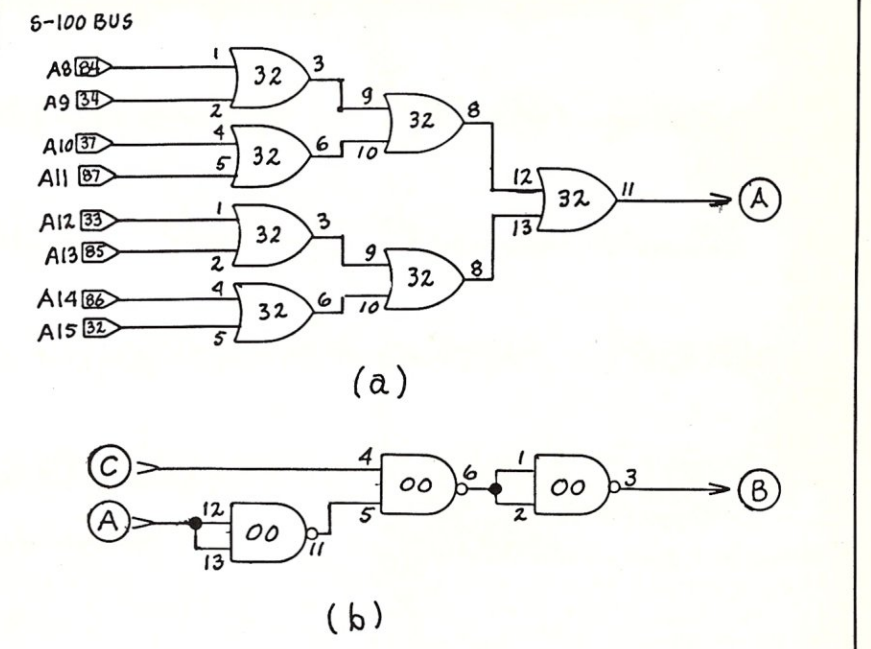

Figure 1 - a)Address decoding of A8 to A15. Required for all three CompuPro boards. b) Circuit that ANDs low byte with high byte for use with INTERFACER-4 CompuPro Board only.

RESULTS

The additional decoding works well and there are no longer strange commands and control codes issued by the CompuPro system I/O boards that wreak havoc with my new addition to the system's I/O space.

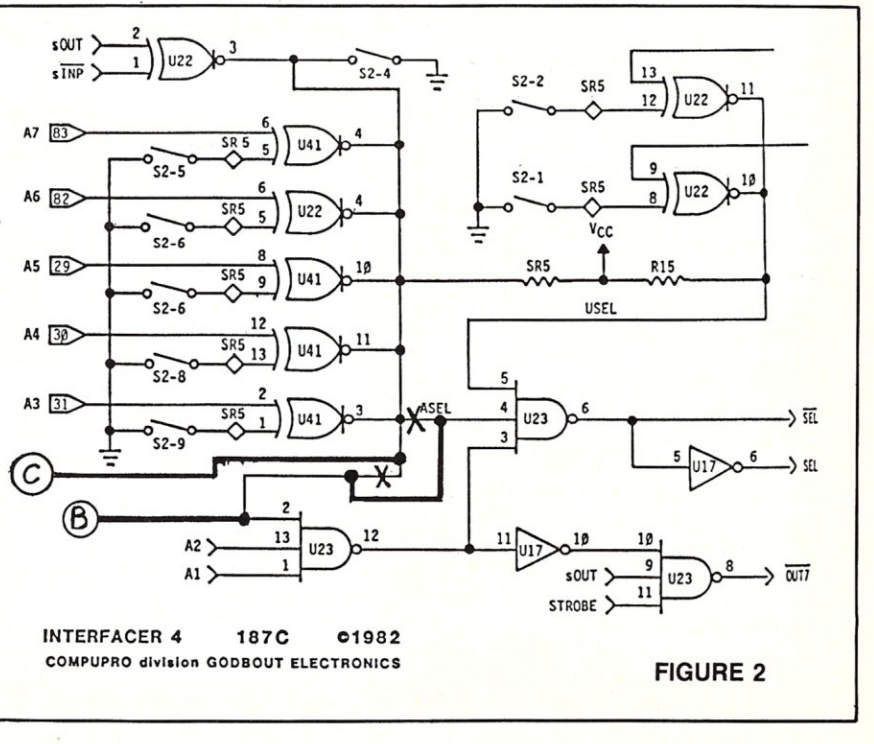

FIGURE 2

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8086/88 Assembler with Translator

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- A Z-80 to 8086 translator
- 64 page user manual
- 4 linkers included:
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  - –CPM/86 produces .CMD file
  - –Pure object code generation
  - –Object code and address information only

Linker features:

- Links up to 128 files
- Submit mode invocation
- Code, Data Stack and extra segments
- Handles complex overlays
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Z-8000 Cross Development Package

Instant Z-8000 Software! This package allows development and conversion of software for the Z8001, 8002, 8003 and 8004 based machines on a Z-80, Z-8000 or 8086 machine. This powerful package includes:

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The Translators provide Z-8000 source code from Intel 8080 or Zilog Z-80 source code. The Z-8000 source code used by these packages are the unique 2500AD syntax using Zilog mnemonics, designed to make the transition from Z-80 code writing to Z-8000 easy.

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Hex File Converter, included—for those who have special requirements, and need to generate object code in this format.

Cross reference table generated—

Plain English Error Messages—

System requirements for all programs: Z-80 CP/M 2.2 System with 54k TPA and at least a 96 column printer is recommended. Or 8086/88 256k CP/M-86 or MSDOS (PCDOS).

Cross Assembler Special Features

Z-8—User defined registers names, standard Zilog *and* Z-80 style support. Tec Hex output option.

8748—standard Intel *and* Z-80 style syntax supported.

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6800 Family—absolute or relocatable modes, all addressing modes supported. Motorola syntax compatible. Intel Hex or S-Record format output.

6502—Standard syntax or Z-80 type syntax supported, all addressing modes supported.

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Z8	199.50	500.00	199.50	199.50	199.50
8086/88	199.50	750.00	99.50	99.50	199.50
80186	199.50	750.00	199.50	199.50	199.50
8748	199.50	500.00	199.50	199.50	199.50
8044/51	199.50	500.00	199.50	199.50	199.50
8080	199.50	500.00	199.50	199.50	199.50
8085	199.50	500.00	199.50	199.50	199.50
8096	199.50	500.00	199.50	199.50	199.50
68020	399.50	750.00	399.50	399.50	399.50
68000,08,10	299.50	750.00	299.50	299.50	299.50
6800,02,08	199.50	500.00	199.50	199.50	199.50
6801,03	199.50	500.00	199.50	199.50	199.50
6804	199.50	500.00	199.50	199.50	199.50
6805	199.50	500.00	199.50	199.50	199.50
6809	199.50	500.00	199.50	199.50	199.50
32000	399.50	750.00	399.50	399.50	399.50
COPS400	199.50	500.00	199.50	199.50	199.50
NSC800	199.50	500.00	199.50	199.50	199.50
6301	199.50	500.00	199.50	199.50	199.50
6501/11	199.50	500.00	199.50	199.50	199.50
6502	199.50	500.00	199.50	199.50	199.50
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CONCLUSIONS

Ideally, when making use of the 16-bit I/O space, one should decode completely A8 to A15 for all of the S-100 I/O boards. An example of this is provided here for the CompuPro I/O boards. This will avoid any possible future I/O space conflicts. However, you could make use of whatever salvagable address decoding there was available on the CompuPro boards. For instance A12 to A15 is decoded by U36 on the System Support board or a single 74LS32 IC might be used to decode A12 to A15 on the DISK 1. Thus, while the additional I/O decoding may not be absolute, (since A8 to A11 would not be decoded) it could be adequate for your I/O application. Whatever way you decide to decode your I/O space, I strongly recommend that an I/O map be made. For each peripheral port function, describe completely bits A0 to A15 and you will never fall into the trap of incomplete decoding for 16-bit I/O space. Of the 64 K I/O space, there is plenty to spare, for now anyway.

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R. Gerson is a physicist at the Ontario Cancer Institute, Princess Margaret HOSPITAL, Toronto. He designs, builds and tests diagnostic medical imaging equipment, and does research in medical imaging related to cancer and arterial disease. Rick obtained his honors B.Sc. at Dalhousie University, in Halifax, Nova Scotia and his M.Sc. at McGill University in Montreal. He has also written articles for computer magazines such as "Computing Now" and "Micro Cornucopia."

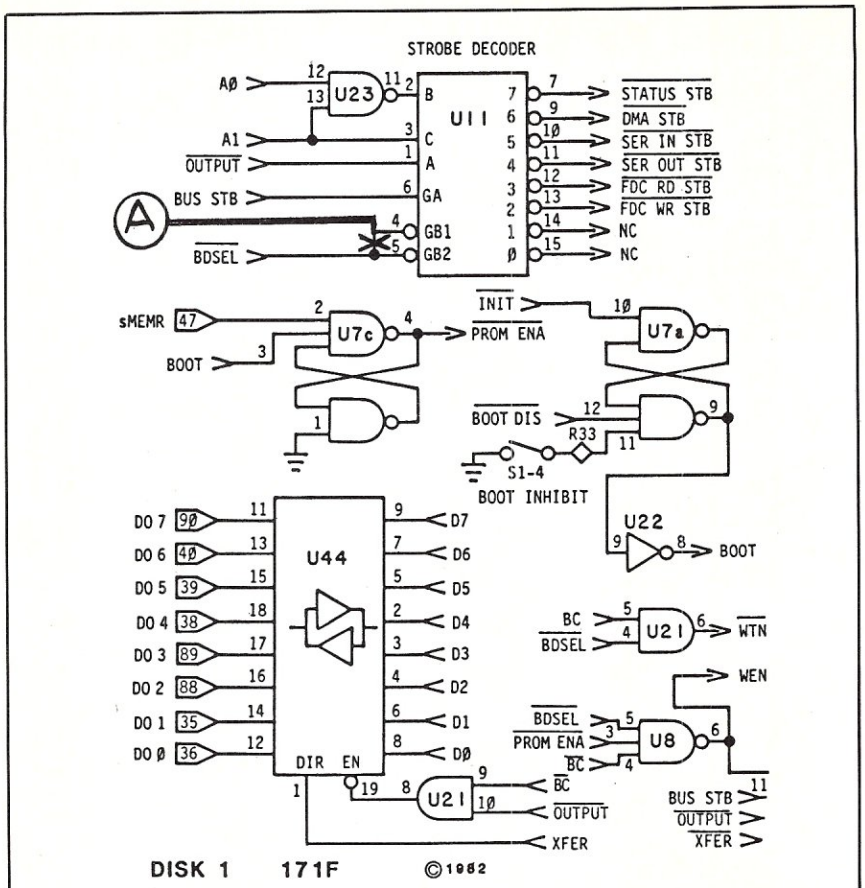


FIGURE 3

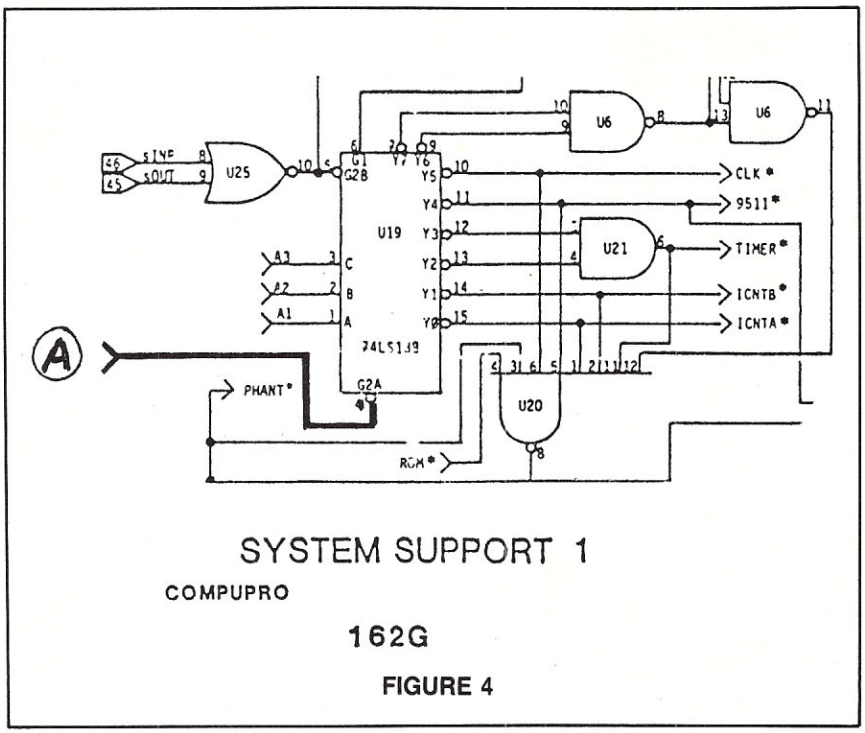
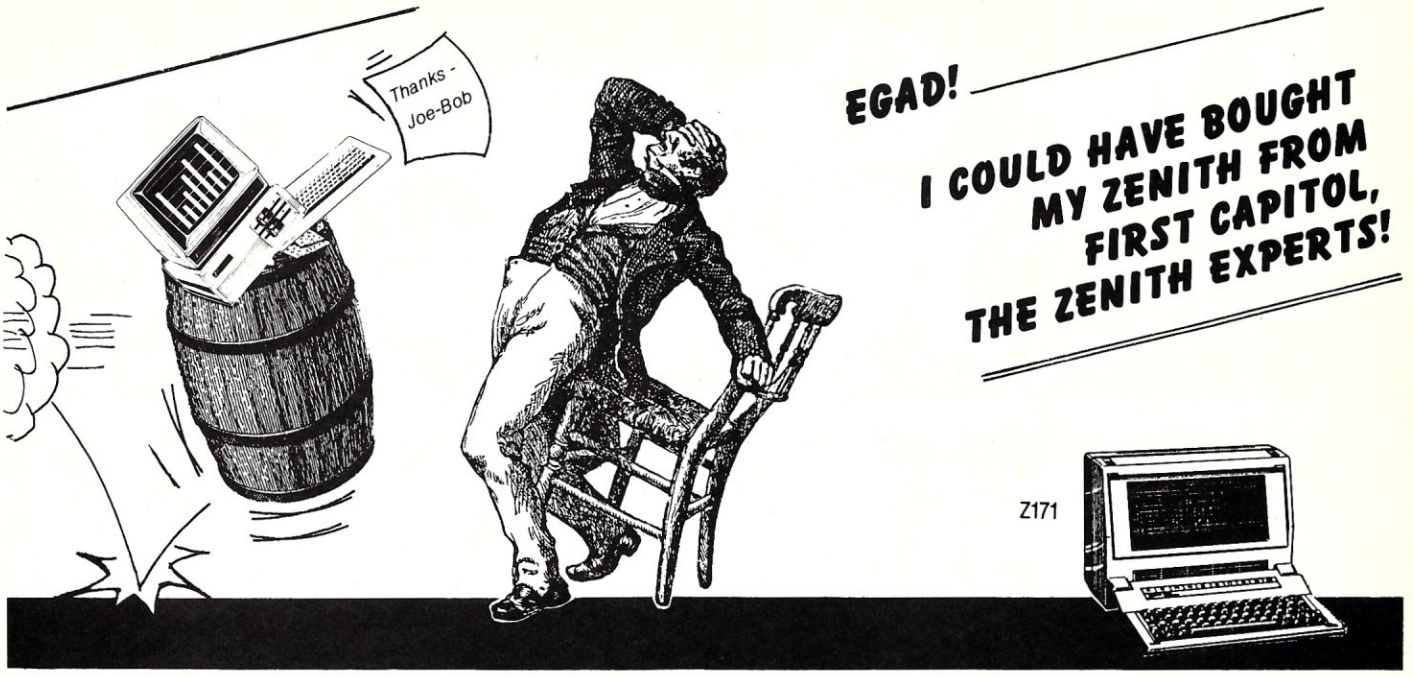


FIGURE 4



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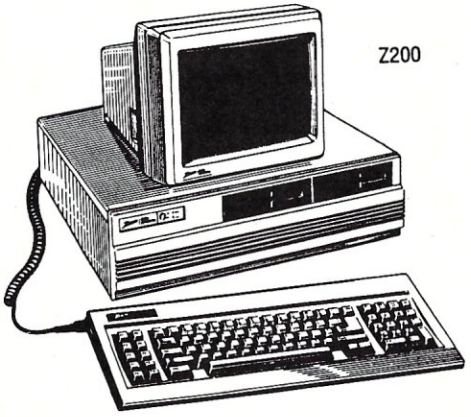

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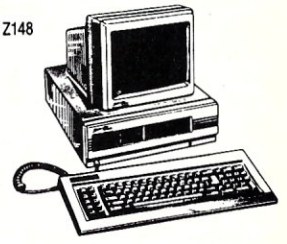

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Hardware Review

The CompuPro 10 Plus

by Michael Guttman

An Economical High Performance CP/M-based Multi-User System With LAN option

Early this year Bill Godbout's well known microcomputer company, CompuPro, changed its corporate name to Viasyn. Whatever its name, the company's product line has long had a reputation for excellence and innovation. Buyers, particularly those in the scientific and engineering market, have always looked to CompuPro for exacting quality, high performance and bedrock reliability. Now Viasyn has introduced a new product, the Compupro 10+, aimed to meet the somewhat different needs and concerns of the business market.

The CompuPro 10+ integrates four PCs into one box at a very attractive price. Each user gets his own Z80 processor and shares an 8088 for job control and 16-bit applications, all runing under Digital Research's Concurrent CP/M operating system (CCP/M).

This multi-processor approach gives all users good performance while allowing them to share the hard disk, printers and other peripherals. The unit we reviewed, which includes a 40MB hard disk, is priced at just $6995. Even with another $2000 or so for four terminals, the CompuPro 10+ comes out a definite winner in the price per workstation category.

Viasyn further sweetens the pot by bundling in some $1000 worth of software. This includes an excellent word processor (NewWord, a Wordstar clone), a first-rate spreadsheet (Supercalc II), as well as Friday!, a toned-down database manager from Ashton-Tate aimed at the novice user. Viasyn has also thrown in Hyper-Typer, a typing practice program, the Field Companion, an easy-to-use executive record keeper, and AMCALL and MCALL II, two communications programs each supporting auto-answer, auto-dial modems and bi-directional file transfers to other computers.

The 10+ will not, of course, have a universal market. It is basically an 8-bit machine in a world that is increasingly in a 16- and 32-bit orbit. However, CompuPro is betting that the tens of thousands of satisfied users of Morrows, Kaypros, Osbornes and, of course, CompuPros, will warm to a machine like the 10+ that can offer them compatible multi-user capabilities at such a reasonable price.

CompuPro also hopes that some current IBM-PC and PC-compatible users may choose the 10+ after balancing its price and performance against that of a comparable PC-based local area network, which might easily cost $12,000 or more and offer substantially less throughput. To woo these buyers further, CompuPro is offering a version of Datapoint's sophisticated and comprehensive ARCnet networking system that can link together up to 255 clusters of PCs, CompuPros, or compatible mini-computers. CompuPro buyers can therefore plan to keep using their favorite PC and software while letting the 10+ handle many other tasks at a better price/performance ratio.

All of this describes a very interesting product which is, however, neither quite fish nor fowl in the current marketplace. Those familiar with other multiuser systems may be puzzled by a product that comes stock for four users - no more, no less - and with little capability for expansion except via networking. PC users will, of course, wonder what the 8-bit world can possibly do for them. Viasyn's customers will certainly be those who have broken out of the common mold and see value in the 10+'s new approach.

A DAY IN THE LIFE

The 10+ is typically configured with a user shell that requests a user's name and password and then displays a menu of available software. This makes life simple for the new or occasional user who just needs to get on and crank out a letter, spreadsheet, or mailing list. The more sophisticated user can exit to the operating system to perform other functions and/or customize the shell to his own special needs.

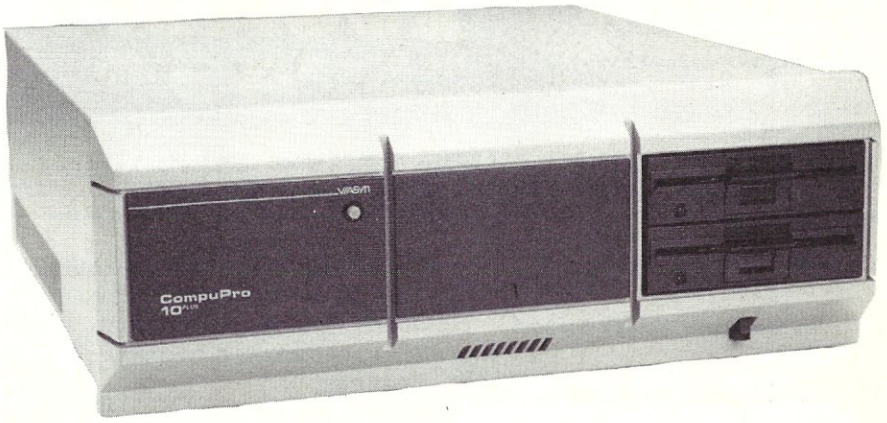
The most striking feature of the 10+ is that four users running simultaneously seem to generate no apparent system degradation, even when they are concurrently accessing the hard disk, which really whips right along. Users operating independently simply won't notice each other's presence, while users sharing common data will generally be quite pleased at the rapid overall throughput.

CCP/M on the 10+ functions very much like its predecessor MP/M, the multiuser version of CP/M. CCP/M is normally implemented on 16-bit-only systems, where its concurrent multi-tasking capabilities allow one user to run several jobs simultaneously, jumping from one to another with a single keystroke. On the 10+, however, such true concurrency has been sacrificed in the names of simplicity and economy, since the Z80 coprocessors will not support it.

Users do derive some indirect benefit from CCP/M, since its advanced multi-tasking architecture properly supports CompuPro's sophisticated networking scheme. In the networking mode, CCP/M can efficiently handle simultaneous requests to and from other nodes and

clusters while making these appear to the user as though the requests were merely local.

Otherwise, users already familiar with CP/M and MP/M will be right at home. Those who have already amassed a library of CP/M software and data will find that the CompuPro floppy drives will automatically read and write a wide variety of formats. They will even work with PC-DOS disks, making it easy to transfer files to and from a PC. Be forewarned, however, that the 10+ will not recognize or follow subdirectories or paths, as in DOS 2.0, and, of course, will not run programs in PC format. In normal operation, the two floppy drives are 96 TPI (tracks per inch) and hold 800 Kbytes each. This allows the average user more than enough space for easy backups of his personal files. Those using software that generates large amounts of data, however, will probably want to lay out an extra $995 for CompuPro's internal 20MB half-height tape cartridge backup system. For real heavy duty users, CompuPro also allows for addition of up to three more hard disk drives.



UNDER THE HOOD

The magic behind the 10+'s quiet power is more apparent after a look around the inside of the chassis. On the right side sit the floppies, the 40MB hard disk, and the power supply, with a very quiet cooling fan mounted rear center. On the left-hand side of the chassis floor is the motherboard, containing the 8088 processor, 786K of RAM, a socket for an optional 8087 math coprocessor, and a 5-slot expansion bus.

Two of these slots contain coprocessor cards, each with two Z80s and 128 RAM, bringing the total RAM to one megabyte. Another slot contains the disk controller, and two slots remain for communications and networking. Out the back are connectors for four workstations, one parallel and two serial printers, one external disk cable and an RS-232 modem. All components are first-rate and there appears to be no evidence of hardware patches or retrofitting.

CompuPro has eschewed the S-100 bus, its former mainstay, in favor of a proprietary scheme that it claims saves space and money and improves performance. Inveterate hackers and purists may condemn this unorthodoxy, but the overall effect is a clean, uncluttered design that should make for very easy maintenance and trouble-shooting and yet preserves a relatively small footprint. At 20'' wide, 8'' high, and 22'' deep, the 10+ should fit unobtrusively into almost any workspace and give years of quiet, uncomplaining service. Viasyn's own confidence in its product is demonstrated by a one full year on-site warranty agreement standard for the 10+.

FIDDLING AROUND

Although the 10+ is supposed to be a closed box, off-limits to hackers, we naturally couldn't resist fooling around a little to find out what really makes it tick. We want to thank the technical staff at Viasyn for graciously putting up with our unceasing questions.

As we noted before, the 10+ has five microprocessors - a shared 8 MHZ 8088, and a dedicated 6 MHZ Z80B for each work station. The system contains a total 1024K RAM, the maximum amount of memory that an 8088 can directy address. The high 256K is broken up into four 64K partitions, the maximum amount of memory that a Z80 can directly address. Each 64K is shared by a Z80 and the 8088, allowing the two processors to communicate almost directly. The remaining 786K can only be accessed by the 8088 processor; however, up to 512K can be used as a RAM disk.

To accomodate this unusual configuration, the 10+ uses a highly modified version CCP/M-86. The modifications allow the user to run either an 8-bit CP/M-80 program or a 16-bit CP/M-86 program, with any mix of jobs possible among the different users.

When the system powers up the 8088 becomes active first. CCP/M-86 is loaded into low memory occupying 150K. The 8088 then loads into each Z80's 64K memory partition what CompuPro engineers call an ''intro'' program. The intro program performs one of two tasks, depending on whether an 8- or a 16-bit job is running.

When an 8-bit Z80 program is running, the intro program intercepts all disk I/O calls to the CP/M-80 operating system and translates them into their equivalent CP/M-86 calls. The Z80 then triggers the call by interrupting the 8088. After the 8088 completes the disk I/O call, execution is returned to the Z80. The 4K intro program effectively replaces CPM-80, but it is much smaller, leaving as much as 20K extra for application programs.

When a 16-bit 8088 program is running, the intro program acts as a terminal handler, using the Z80 to lessen the load on the 8088. Any CP/M-86 terminal I/O is passed to and from the 8088 through the memory it shares with the Z80s.

When a CP/M-80 program is running, the 8088 is only used for disk I/O. An execution-bound Z80 program will not strain the 8088 or significantly affect other users. When one or more CP/M-86 programs are running the 8088 is timeshared. This means that execution-bound 8088 programs will slow down other 16-bit programs and could possibly slow down disk-intensive Z80 programs.

The lower 768K bytes of memory which are not normally used by CP/M-86 can by used for 8088 programs with an ''on demand'' allocation method. One of the more grueling tests we made was to start on each port a 16-bit program which displayed a sorted disk directory. The program was run continually via a batch file. When we started this program on the last port we received an error message ''not enough memory''. We tried several times to get the program to run, but usually received the error message ''unknown error number 8'' until just the exact moment that one of the 16 bit jobs running on

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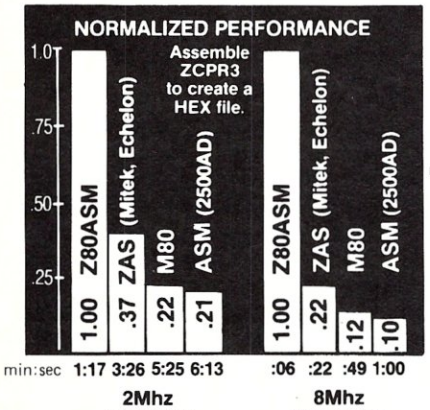

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another port finished, freeing enough memory for the new job to start. When the port that freed up the memory tried to restart its program it would abort because of "not enough momory" or "unknown error number 8."

Since the program was a small one, we were confused. We finally figured out that running both the batch file and the directory sort on each user port gobbled up more memory than we had anticipated, leaving insufficient memory for all tasks. To it's credit, however, the system never crashed or hung.

THE WRITE TO KNOW

In keeping with Viasyn's philosophy of insulating the user from the technical trappings of the system, standard documentation for the 10+ is rather sparse. Substantial confidence in his local CompuPro Systems Center is a clear prerequisite for all but the hardiest 10+ customer. Viasyn does provide an 18-page user guide and a 24-page installation guide, adequate and not overwhelming for the novice user. They also provide Viasyn's own Bits, Bytes, and Buzzwords, a clearly written, if rather biased, introductory pamphlet to computers and computer lingo. Of course, complete manuals are provided for all the bundled application software.

Upon request, CompuPro also provides a standard set of Digital Research Concurent CP/M-86 manuals which consists of a user's guide, a system guide, a programmer's reference guide, and a programmer's utilities guide. However, because of the major changes made by CompuPro to CCP/M, the user's guide is of little use, and the system and programmer's guide are best left to those already well versed in the complexities of operating systems. Ah well, back to the local systems center...

DECISIONS, DECISIONS...

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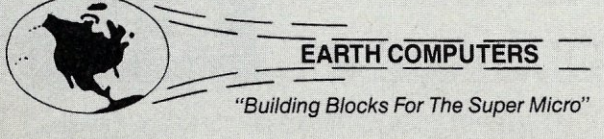

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Program Interfacing To MS-DOS

by William G. Wong

Part III - Basic File Access Functions

MS-DOS has two sets of file access functions. One set is almost identical to the CP/M file access functions while the other is similar to the UNIX-style functions. The initial version of MS-DOS only supported the CP/M-style functions with the UNIX-style functions being added in version 2. This article covers the basic CP/M-style functions. The UNIX-style functions will be covered in Part IV.

For the most part, the two sets of functions perform the same operations. The difference between them is in the control block and file access modes used. The CP/M-style functions use a reference to memory array called a File Control Block (FCB). The UNIX-style uses a reference called a "handle" which is a 16-bit integer. This is similar to an FCB reference except that it is generated by the operating system and given to a program whereas an FCB is part of a program's data space.

MS-DOS actually has an array of items similar to an FCB which it uses in conjunction with the UNIX-style file functions. The handle is used to address this array. The value of a handle must be given to a program when a file is opened because the program does not know the location or structure of this array.

The advantage of the CP/M-style functions was compatability with the CP/M and CP/M-86 operating systems since many of the initial applications for MS-DOS came from machines using the CP/M operating system. This is still a viable reason for using these functions, plus it allows some applications to be moved back to a CP/M environment. These functions also provide a familiar environment for programmers that work with CP/M.

The disadvantage of the CP/M-style functions comes with the method of operation and use of the FCB. The CP/M-style file functions are record oriented while the UNIX-style functions are stream (byte) oriented which is more flexible. The use of the FCB is a disadvantage because its structure is complex and the order in which certain fields are manipulated is important which complicates matters. It also restricts future system enhancements because the structure must remain fixed, otherwise, applications would have to change to accommodate additional fields in an FCB. Finally, the existing FCB does not easily support the subdirectory capability added in version 2 of MS-DOS.

The advantage of the UNIX-style file functions is the simpler interface and more powerful mode of operation including direct support for subdirectories. Also, future enhancements to MS-DOS are more easily incorporated into MS-DOS without impacting existing applications because the control block is internal to MS-DOS and not to an application. This allows the internal MS-DOS file control block to completely change between releases without changes to programs which run under MS-DOS.

The UNIX-style functions also provide a bridge to the UNIX-type operating systems. This is important for moving applications to and from these types of systems which are often multi-user machines whereas the current version of MS-DOS is single user.

The only disadvantage for the UNIX-style functions is the incompatability with the CP/M-style functions. This is of little consequence for new programs.

So why the two types of functions? Compatability and growth. The CP/M-style functions provided the initial environment of compatability for program migration. The UNIX-style functions provide growth path for new applications. It also is an environment which is compatible with UNIX environments.

The CP/M-style functions are covered first since they were implemented first.

BASIC CP/M-STYLE MS-DOS SUPPORT

The CP/M-style MS-DOS file functions use the MS-DOS File Control Block (FCB) to refer to a particular file on a disk. The MS-DOS FCB is divided into three parts. The first is the basic FCB which contains information about the file name, size, and current record status. The second is the random record number which appears at the end of the FCB. This is only required if the random record functions are used. The final item is a new addition to MS-DOS which did not appear in the CP/M systems. It is called an extended FCB. The extended portion of the FCB appears before the normal FCB and is seven bytes long. In this case, the address of the FCB used with the CP/M-style MS-DOS file functions is the address of the extended FCB.

The fields of the basic FCB are described in table 1.

Table 1

MS-DOS File Control Block (FCB)
(All values are in hex)

Offset	Size	Description
00	1	Drive letter
01	8	File name
09	3	File type
0C	2	Current block (128 records/block)
0E	2	Logical record size in bytes
10	2	File size in bytes (low part)
12	2	File size in bytes (high part)
14	2	Date
16	A	Reserved
20	1	Current record in current block
21	2	Random record (low part)
23	2	Random record (high part)

The drive number contains the drive where the file is to be found. Drive A corresponds to a 1, B to a 2, and so on. The default drive is specified by 0. The default drive will be replaced by the actual drive number after the file is opened. The file name and type must be left justified with trailing blanks.

The current block number and current record number are used to determine the next record to be accessed when using the sequential read and write functions. A block contains 128 records and the current record number specifies the logical record within the current block. The logical record size is initially set to 128 bytes (80 hex) but it may be changed after a file is opened.

This allows a file to contain record sizes different from the normal CP/M-style 128 byte records.

The date field specifies when a file was created or last updated. The word value (least significant byte first) is used in the following fashion:

Bit Offset	Size	Description
0	5	Day of the month (1-31)
5	4	Month in year (1-12)
9	7	Year from 1980 (0-119) with range of 1980 to 2099

The extended FCB includes the following seven byte field immediately before the normal FCB.

Offset	Size	Description
-7	1	Must be 0FF hex
-2	5	Zeros
-1	1	File attribute

The first byte of the extended FCB must contain the value 0FF-hex. This allows MS-DOS to determine that an extended FCB is in use because 0FF is an invalid drive number and could not appear in a valid basic FCB. The extended FCB provides access to the file attribute byte. The value can be examined or modified by the program. The following table describes the contents of the file attribute byte.

Bit	Description
0	File is marked read-only
1	Hidden file
2	System file
3	Volume label
4	Reserved
5	Archive bit
6-7	Reserved

The next section describes the functions which use the FCB. No further reference will be made to the basic or extended FCB since they may be used interchangably.

BASIC DOS FILE FUNCTION OVERVIEW

The CP/M-style MS-DOS file functions can be divided into a number of catagories. The first are basic disk support functions such as setting the default disk or getting the amount of free space on a disk. These functions do not use the FCB reference. The second set of functions are the directory manipulation functions and are used to rename or delete files. These functions use an FCB but are essentially standalone operations in that the FCB is not required for subsequent operations. Finally, there is the file data manipulation functions like open, read, write and close. These functions use an FCB in an activated state. That is, and FCB is first activated (opened or created). Then the same FCB must be used to perform read and write operations and then it may be closed. It is illegal to use and FCB with these functions (except open and create) unless the FCB is first activated.

The following table lists the CP/M-style functions by function code. The remaining sections describe the operation of the functions by catagory.

Function Code	Description
0D	Disk Reset
0E	Select default disk
0F	Open file
10	Close file
11	Search for first entry
12	Search for next entry
13	Delete file
14	Sequential read
15	Sequential write
16	Create file
17	Rename file
19	Return current disk
1A	Set Disk Transfer Address (DTA)
1B	Allocation table information address
1C	Allocation table for specific drive
21	Random read
22	Random write
23	File size
24	Set random record field
27	Random block read
28	Random block write
29	Parse file name
2F	Get disk transfer address (DTA)
36	Get disk free space

DOS FILE NAME PARSING

One of the first things to notice about the DOS FCB is that the file name and type are in separate fixed size fields that are filled with trailing spaces. This is fine for fixed file names which may be included as part of a file since they may be defined as constants whose format is the same the FCB fields. Unfortunately, user entry of files names normally results in a string of characters which has the following format:

d:filename.typ

where *d* is the drive letter, *filename* is a file name up to the 8 character limit, and *typ* is the file type which is up to 3 characters. The drive and file type are optional. In addition, the file name and type may include wild card characters, '*' and '?'.

This leads to quite a number of combinations. Converting this file name format into an FCB can be accomplished with the Parse File Name function. This definitely takes a burden off the programmer because the function handles all the formatting and validation required by MS-DOS.

The function is very simple to use. It requires the address of the string to be parsed in DS:SI and the destination FCB in ES:DI. Control over the parsing operation is done using a parameter in the AL register. The result returned in the AL register, along with the first character in the destination FCB, are used to determine if the parse operation was successful. The following is an example of the parse file name function:

```
LDS SI,SOURCE   ;DS:SI:= string address
LES DI,FCB      ;ES:DI:= FCB address
MOV AL,1        ;AL:= skip leading spaces
MOV AH,29H      ;AH:= Parse file name
INT 21H         ;AL:= result
```

The source string scanning will terminate if a valid file name is parsed or a file name terminator character is encountered. The DS:SI registers point to the first character following the parsed file name.

Leading space characters include:

: ; , .

plus the space and tab characters. File terminator characters include the separator characters, control characters and:

\ < > | / [ ] "

The parse parameter contained in the AL register is defined as:

Bit	Description
0	skip leading separators
1	change drive number only if specified
2	change file name only if specified
3	change file type only if specified
4-7	reserved, must be zero

Bits 1 to 3 assume the destination FCB has been initialized. During the parse operation, the '*' character causes the current field (file name or type) to be filled with trailing '?' characters.

The result returned in the AL register is defined by the following table:

AL	Description
00	valid specific file name
01	file name or type contained * or ?
FF	drive specified is invalid

Finally, the parse operation is successful if the first character in the file name field is not a blank.

DISK TRANSFER ADDRESS (DTA) FUNCTIONS

The disk transfer address is used by a number of support functions in addition to the file access functions. In general, it is used to point to a buffer area where data is read or written. The disk transfer address can be changed at any time using the following function.

```
LDS DX,DTA  ; DS:DX := new address
MOV AH,1AH  ; AH := function code
INT 21H     ; Set disk transfer address
```

Often it is useful to get the current disk transfer address so it can be restored after it is changed for subsequent operations. The following example shows how to get the current disk transfer address into the ES:BX registers.

```
MOV AH,2FH ; AH := function code
INT 21H    ; ES:BX := Get disk transfer
           ; address
```

DISK SUPPORT FUNCTIONS

The MS-DOS disk support keeps track of the various drives in the system. Often, during an application, the user must change the diskettes which are in a drive. CP/M and the initial versions of MS-DOS required an application to tell MS-DOS that such a changed was going to occur. This is done using the disk reset function as in:

```
MOV AH,0DH      ; AH := Disk Reset
INT 21H         ; do disk reset
```

Newer versions of MS-DOS can automatically detect disk change operations but it is best to use the disk reset function anyway.

The MS-DOS command level prompt contains a letter specifying the default disk. This disk is used by MS-DOS whenever it encounters a file name, at the command level or in an FCB, which does not specify a disk drive explicitly. MS-DOS supplies two functions which allow a program to determine the current default disk and change its value. The following code fragment shows a function which will set a new default disk value and return the previous value.

```
PUSH AX     ; save new default disk
 MOV AH,19H ; AH := Return current disk
 INT 21H    ; AL := current disk
POP DX      ; AL := new default disk
PUSH AX     ; save  old default disk
 MOV AH,0EH ; AH := Select default disk
 INT 21H    ; set   new default disk
POP AX      ; AL := old default disk
```

Located on each disk is an array called the File Allocation Table (FAT). In the initial versions of MS-DOS, the entire FAT was resident in memory when a disk was in use. In addition, disk specifications such as sector size was kept for each drive. Access to this information was accomplished through two MS-DOS function calls which returned the address of the allocation table. This information was normally used to determine the amount of free space left on a disk. This was computed using the allocation information and the FAT. Starting with MS-DOS version 2, the entire FAT for a particular drive was not resident in memory. Therefore, a Get Disk Free Space function was included. The following examples show how this information is accessed.

```
MOV AH,1BH ; AH := get allocation table
INT 21H    ; DS:BX :=  allocation table

MOV DL,1   ; AL := drive A:(2 = B:,etc.)
MOV AH,1CH ; AH := get allocation table
INT 21H    ; DS:BX :=  allocation table
```

```
Function 1B and 1C Results
--------------------------

AL      Sectors per cluster
DS:BX   FAT identification byte address
CX      Bytes per sector
DX      Total clusters
```

The Get Disk Free Space function can also be used to check for a valid drive. The following example shows how to get the amount of free space for drive A:.

```
MOV DL,1   ; AL := drive A: (2 is B:)
MOV AH,36H; AH := Get disk free space
INT 21H    ; AX := FFFF if invalid drive
```

```
Function 36 Results
-------------------

AX    FFFF hex if drive is invalid

AX    Sectors per cluster
BX    Free clusters
CX    Bytes per sector
DX    Clusters on disk
```

In all cases, the amount of space in bytes or the amount of free space is found by using the appropriate results.

DIRECTORY SUPPORT FUNCTIONS

Subdirectories are not supported under the CP/M-style functions except for the current subdirectory which can be set from the MS-DOS command level or using the UNIX-style function. All the CP/M-style directory and file access functions operate using the current subdirectory if one has been specified.

The first directory function is the *Delete File* function. This function requires an unopened FCB with the name of the file, or files if wild card characters are used. The result is returned in the AL register. The value is zero if files are deleted and 0FF-hex if no files are deleted. The following example shows how to delete all the files on the current drive.

```
LDS DX,ALLFILES;DS:DX := FCB index
MOV AH,13H     ;AH := Delete files
INT 21H        ;AL := no files deleted


ALLFILES:
   DB 0             ;default drive
   DB '???????????';all files file name
   DB 21 DUP ( ? ) ;rest of FCB
```

Renaming files is accomplished using the *Rename File* function. This function also uses an unopened FCB and supports wild card characters in the file name. The result is returned in the AL register and zero indicates all matching files are renamed. A value of 0FF-hex is returned if no files are renamed or if the new name of a file matches one already in the directory. The current file name pattern is located in the normal file name field of the FCB. The new file name pattern is located at offset 11-hex from the start of the FCB. Any '?' characters in the new file name pattern are not changed in a matching file name. The following example renames all files with the file type TXT to files with the same name but a file type of ASC.

```
   LDS DX,RFCB      ;DS:DX :=rename FCB
   MOV AH,17H       ;AH :=Rename file
   INT 21H          ;AL :=rename result


RFCB:
   DB 0             ;default drive
   DB '????????TXT';current file name
   DB 6 DUP ( 0 )  ;filler
   DB '????????ASC';new file name
```

Next, there are two directory functions which can be used to determine what files exist in a directory. The reason for having two files is that one function is used to find the first occurrence of a file name while the other is used to find subsequent occurrences of matching file names. Obviously, wild card characters can be used to find multiple files.

These functions require both an unopened FCB and the current data transfer area. The FCB may be an extended FCB. The *Search First* and *Search Next* functions use the same parameters and return the same results. The disk transfer address must be set before these functions are called. The parameter is the FCB address. The result is returned in the AL register with a zero indicating a file was found and 0FF-hex indicating no file was found.

The disk transfer area contains an unopened FCB which matches the search FCB type (normal or extended). The unopened FCB contains the file name found in the search. The search FCB is modified so a subsequent *Search Next* operation will find the next file in the directory if it exists. The contents of the search FCB should not be modified if a Search Next operation will be performed. The following example shows how the second matching file name in the directory can be found.

```
LDS DX,RESULT;DS:DX := result address
MOV AH,1AH    ;AH := function code
INT 21H       ;Set disk transfer address
LDS DX,FCB    ;DS:DX := pattern FCB
MOV AH,11H    ;AH := Search first
INT 21H       ;AL := file not found
```

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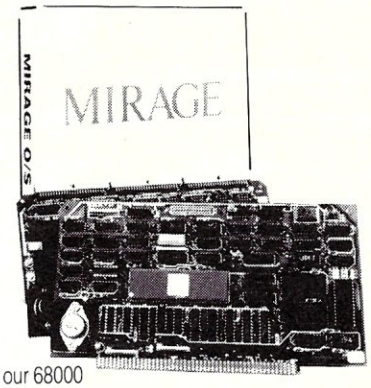

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```
                ; this find:=Open file
                ; any file
    INT 21H     ; AL :=no file opened


    LDS DX,FCB  ;DS:DX := FCB address
    MOV AH,10H  ;AH := Close file
    INT 21H     ;close file


XFCB:
    DB 0FFH         ;XFCB marker
    DB 5 DUP ( 0 ) ;reserved
    DB 7            ;search for any file
FCB: DB 0           ;default drive
    DB 'FILENAMETYP';FILENAME.TYP
CBLOCK:
    DW 0            ;current block
RECSIZE:
    DW 80H          ;record size
FILESIZE:           ;file size
    DW 0            ;low  part
    DW 0            ;high part
DATE:
    DW 0            ;access date
    DB 10 DUP ( 0 );reserved
CRECORD:
    DB 0           ;current record
RRECORD:           ;random record number
    DW 0           ;low  part
    DW 0           ;high part
```

Sequential file operations can occur after a file is opened and the current record is set. The record size should also be modified before a sequential file operation is done if the default value of 128 bytes is incorrect. All file read and write operations use the area addressed by the MS-DOS disk transfer address mentioned earlier. This value should be changed before an operation is done. For example, if a number of sequential records are to be read into an array then the disk transfer address should be set to the base of each subsequent element before the the *Sequential Read* operation is performed. The disk transfer address does not need to be constantly updated if records are to be read into the same buffer area.

MS-DOS uses the current block and record values to determine which record is being transfered. These values are updated to the next sequential value after each transfer. Therefore, the contents of an entire file can be read by performing only Sequential Read operations after a file is opened. The open FCB address is passed in the DS:DX registers and the transfer result is placed in the AL register. The values are shown in the following table:

AL	Description
00	Transfer completed
01	End of file, no data
02	Not enough space on disk
03	End of file, partial record

The following examples show the *Sequential Read* and *Write* functions:

```
                ; DTA already setup
LDS DX,FCB      ; DS:DX := open FCB
MOV AH,14H      ; AH := Sequential read
INT 21H         ; AL := result

                ; DTA already setup
LDS DX,FCB      ; DS:DX := open FCB
MOV AH,15H      ; AH := Sequential write
INT 21H         ; AL := result
```

The sequential file operations do not use the random record field (4 bytes) and this area need not be included in the FCB size if the FCB is only being used with sequential file operations. However, it is often useful to determine the current record number in a sequential operation. In this case the *Set Random Record Field* function can be used to convert the current block and record numbers into a random record number. The random record number field updated with this value and no results are returned. The following example shows how the function is invoked.

```
LDS DX,FCB      ; DS:DX := FCB address
MOV AH,24H      ; AH := Set random record
INT 21H         ; set random record field
```

Random file operations are used in a number of applications such as accounting and data base programs. MS-DOS provides two sets of random

file functions. The first transfers only one record while the second set can transfer a specified number of records. The result returned in AL is the same as for the sequential operations. The major difference between the two sets is that the single record transfer functions DO NOT change the value of the random record field while the multiple record transfer functions do. In either case, the random record fields must be set to the proper value before the functions are invoked. The current block and record values are updated to match the random record value during the operation of the functions. The DS:DX registers are still used to address the open FCB to be used. Data is transferred via the MS-DOS disk transfer address (DTA). The following examples show the use of the *Single Record Random File Transfer* function.

```
LDS DX,FCB      ; DS:DX := FCB address
MOV AH,21H      ; AH := Random read
INT 21H         ; AL := read result


LDS DX,FCB      ; DS:DX := FCB address
MOV AH,22H      ; AH := Random write
INT 21H         ; AL := read result
```

The *Random Record Block* functions add the number of records to transfer in the CX register. In addition, the number of records actually transferred are returned in the CX register. The buffer area referenced by the MS-DOS disk transfer address (DTA) must be large enough to hold the number of records being transferred. The current block, current record and random record fields in the FCB are set to the first record following the last one transferred. This allows repetative operations without having to update any of the respective fields. In a sense, the *Multiple Record Transfer Functions* really replace the *Single Record Sequential* and *Random File Access* functions. The following examples show the *Random Block* functions are implemented.

```
LDS DX,FCB      ;DS:DX := FCB address
MOV CX,10       ;CX := number of records
MOV AH,27H      ;AH := Random block read
INT 21H         ;AL := read result


LDS DX,FCB      ;DS:DX := FCB address
MOV CX,10       ;CX := number of records
MOV AH,28H      ;AH := Random block write
INT 21H         ;AL := read result
```

A special case occurs when the CX register is zero for a *Random Block Write*. In this case, the file size is set to match the number of records specified in the random record field. This may cause the file to be truncated or extended depending upon the current size and the random record field value.

SUMMARY

The CP/M-style file functions provided by MS-DOS are identical to the CP/M file functions with a number of enhancements. The ability to specify a record size and transfer multiple records can greatly simplify the coding of applications which use fixed size record based files. Character oriented stream files can be done using a record size of one byte.

The major differences between the CP/M file functions and the MS-DOS CP/M-style file functions is the addition of the file attribute byte and the extended FCB area. Under CP/M, the file attributes were contained in the most significant bits of the file name and type fields.

The next part in this series will cover the UNIX-style file functions provided by MS-DOS.

Bill Wong is the President of Logic Fusion, Inc., 1333 Moon Drive, Yardley, PA 19067, a systems software development firm.

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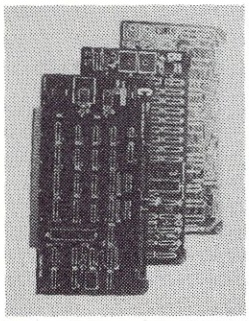

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Typesetting With or Without a Typesetter

by A.G.W. Cameron

A Review of Two TEX Packages to Set Type on a PC or Compatible

About TEX

One of the most exasperating aspects of scientific word processors is that, until now, those that used high-resolution dot matrix printers were very poor at placing symbols at proper positions on a page, and the ones that were good at placing symbols on a page were limited to daisy-wheel printers, on which the availability of special symbols was very poor. The appearance of TEX on the PC scene is thus most welcome news for users who wish to produce mathematical equations of highest quality in a technical manuscript. This article was prepared using TEX and typeset using various output devices driven by appropriate TEX drivers.

TEX is pronounced as though it were spelled 'tek'.

TEX is an extraordinary program for describing a text format to be output on a variety of output devices. It runs on a great variety of mainframe and minicomputers, and for a given input file, which can be produced with any suitable editor, it produces a *device independent*, or DVI file. Both the input and DVI files contain only printable ASCII characters and carriage returns, and the DVI file can be sent to and used on any suitable output device, including ones driven by other computers. TEX was designed by Donald E. Knuth of the Stanford University Computer Science Department with two goals in mind: to be able to phototypeset mathematics in accordance with the highest standards of the typesetting art and to have the results look "beautiful".

Spreading out from Stanford is a devoted group of TEX users who have organized themselves into the TEX Users Group (TUG) which publishes a newsletter called TUGboat. In this are reported the progress in transporting TEX to other computers and progress in getting TEX to do new tricks. There is a feeling among this group that they form a cult and that they are an elite, so they refer to one another as wizards and TEXperts.

TEX employs a very large vocabulary of commands, much to the dismay of technical typists who are called upon to use it. Actually there is a select group of primitive commands, and large numbers of other commands which are defined in terms of primitives and previously-defined commands. In this sense TEX is somewhat similar to a threaded language such as FORTH. These defined commands come in a variety of macro packages designed to do different things, from writing letters to typesetting poems or mathematical articles. To the extent that some procedures are defined in conflicting ways, the use of different macro packages can lead to confusion. Many of the commands are quite lengthy, consisting of two or three English words strung together to form a single command. The extra typing involved is often quite bothersome to TEX users, but one is always free to define a short term to represent a much longer one.

Boxes and Glue

In most word processing programs the process of right justification involves adding words to a line until the next word will no longer fit, in which case the extra word is moved down to start a new line, and the words on the previous line are stretched apart to fill the prescribed line width. The procedures in TEX are much more sophisticated than that. TEX tries to make paragraphs and whole pages look beautiful. To understand how this happens we must learn a little about boxes and glue.

Every letter or symbol is considered to be a box by TEX, which is only interested in how high and deep and how wide it is. TEX assembles these boxes into words, and to TEX a word is just another box with a certain width and height and depth. In turn, the word boxes must be assembled into lines and paragraphs. There are usually many ways in which this can be done, and here the concept of glue enters. Horizontal glue holds word boxes together to make line boxes, and vertical glue holds line boxes together to form paragraph boxes. In turn, paragraph boxes are glued together to make pages. TEX may add a header box or a footer box to the page.

Horizontal glue has a specified width, which is allowed to stretch and shrink by specified amounts. It is frequently the case that a word can be added to the end of a line by shrinking the spaces between the words on the line (shrinking the glue), or the word may be placed on the next line, in which case the horizontal glue on the preceding line is stretched. Since there are usually many lines in a paragraph, there are many combinations of ways in which the paragraph may be broken into lines. TEX tries to achieve the closest approach to uniform interword spacing throughout the paragraph that it can. In order to do this it assesses penalties against those cases in which the glue must be shrunk or stretched too much. The preferred way to break a paragraph into lines is that way with the least assessed penalty.

TEX sets very high standards for this process, and its defaults do not allow much shrinkage or stretching. It will first try to break a paragraph into lines without hyphenating any words. If this can be done within the assigned "tolerance", then the paragraph will be so broken. If this cannot be done, then TEX will try hyphenating words in order to create additional modes for breaking the paragraph. However, TEX will try to avoid having successive lines ending with a hyphenated word. If none of these additional ways is successful, then TEX will complain, probably by creating an "overfull \hbox", which means that the line so labelled will stick out beyond the right margin. There are two ways to fix this. One way is to rewrite the line so that the trouble is eliminated. The other way is to relax the tolerance. It will be obvious that TEX will have more trouble breaking paragraphs into narrow lines than into broad ones. The columns used in this Journal are quite narrow, so I have increased the tolerance to ten times the default that TEX normally uses. Since this whole article

was produced using TEX, you can see that the program did quite a good job of breaking the paragraphs despite this relaxation of its normal tolerances.

Many of the available word processing programs use hyphenation algorithms with various degrees of sophistication, but this tends to be a weak point of many of them. TEX takes a conservative approach to hyphenation. It uses a set of rules which finds some but not all of the places where a word can be hyphenated, and therefore it is quite accurate in the hyphenation that it does do. TEX maintains a list of hyphenation exceptions, and you can help it out by adding to this list, or simply by indicating in your text how some of your specialized but commonly-used words should be hyphenated.

Mathematics

TEX does a lot of things differently when it is handling mathematics. For one thing, all the rules about spacing in mathematics are changed compared to normal English text, a distinction that word processors, even the scientific ones, rarely make. Thus TEX possesses a math mode in two forms, one for equations contained within a line of text, and one for displayed equations. Some spacings, particularly vertical spacings, will come out differently in these two modes, and the font sizes that TEX chooses may also be different. For example, the expression $(a+b)/(c+d)$ may be written as an actual fraction which appears within the line like this: $\frac{a+b}{c+d}$, or it may be displayed like this:

$$\frac{a+b}{c+d}.$$

In both cases the expression that I typed in was `{a+b \over c+d}`. In the first case, to get an equation (or expression) in line, I surrounded this expression by dollar signs, $. In the second case, to get a displayed expression, I surrounded the expression by double dollar signs, $$.

These examples illustrate several features of TEX. The braces { and } serve to group things together, in this case showing what items should appear in the fraction (although in this particular example they are not necessary). The command `\over` tells TEX that the preceeding material appears as a numerator in a fraction and the succeeding material appears in the denominator; the numerator will be centered over the denomenator and a line will be drawn between them equal in length to the longer of the two. The braces are examples of reserved symbols on the keyboard that TEX uses to format the text; the dollar sign, $, is another example of a symbol that is reserved, and in order to print them out they must be preceeded by a backslash.

The basic variety of TEX, called "plain" TEX, has at its disposal 16 different fonts, of which Roman, Bold Extended, Math Italic, and Math Symbols each acount for three fonts in sizes 10, 7, and 5 points. The remaining fonts are Slanted Roman, Text Italic, Typewriter Type, and Math Extension, each available in 10 points. All of these are available in larger point sizes as magnifications of the basic set, with each step in the magnification sequence representing another factor of 1.2 in size. The magnifications available are thus $(1.2)^{0.5}$, $(1.2)^1$, $(1.2)^2$, $(1.2)^3$, $(1.2)^4$, and $(1.2)^5$, called, respectively, magstephalf, magstep1, magstep2, magstep3, magstep4, and magstep5. The PC versions of TEX do not include magstep5. Ten point type at magstephalf is equivalent to 11 point type, and at magstep1 it is equivalent to 12 point type. Other varieties of TEX have many additional fonts available, with most of them existing in additional sizes of 6, 8, and 9 points in the basic set. Examples of other font styles are sans serif, sans serif bold, and capitals and small capitals.

There are command names for the special symbols in these fonts, which makes the task of the technical typist easier. The special language used to express equations is thus remarkably easy to read, particularly in comparison to the conventions used in most technical word processors.

To return to the difference between equations in line and displayed, consider the expression I will enter as `\int_0^\infty f(x)\,dx`. If I put single $ symbols around this, I get $\int_0^\infty f(x)\,dx$, whereas with $$ symbols surrounding the expression I get

$$\int_0^\infty f(x)\,dx$$

Note the change in size of the integral sign, which I entered as `\int`, and the corresponding repositioning of the limits. It will be obvious that `\infty` represents ∞. The combination "\," was entered to introduce a little extra space between $f(x)$ and dx. The special symbols _ and ^ are used to enter the following symbols (or expressions in braces) as subscripts or superscripts, respectively.

If you have followed all of this, you now know nearly enough to begin using TEX. Your next step is to get a copy of *The TEXbook* by Donald E. Knuth (Addison-Wesley Publishing Company, 1984).

I finish the math discussion by showing a more complicated example of a math equation. The above examples were very simple because I wished to demonstrate some simple rules of TEX in setting mathematics. The following expression, taken from *The TEXbook*, is somewhat more challenging:

$$\prod_{j\ge0}\Bigl(\sum_{k\ge0}a_{jk}z^k\Bigr)=\sum_{n\ge0}z^n\Biggl(\sum_{\substack{k_0,k_1,\ldots\ge0\\ k_0+k_1+\cdots=n}}a_{0k_0}a_{1k_1}\ldots\Biggr).$$

The input for this equation is given in the accompanying box.

Within this box are shown the input instructions for the final paragraph of the "Mathematics" section.

```
I finish the math discussion
by showing a more complicated
example of a math equation. The
above examples were very simple
because I wished to demonstrate
some simple rules of \TeX\
in setting mathematics. The
following expression, taken from
{\it The \TeX book}, is somewhat
more challenging: $$ \leftline{$
\displaystyle\prod_{j\ge0}
\biggl(\sum_{k\ge0}a_{jk}z^k
\biggr)=$}$$
$$\rightline{$\displaystyle
\sum_{n\ge0}z^n\,\Biggl(
\sum_{\scriptstyle
k_0,k_1,\ldots\ge0\atop
\scriptstyle k_0+k_1+\cdots=n}
a_{0k_0}a_{1k_1}\ldots\,\Biggr)
.$}$$ The input for this equation
is given in the accompanying box.
```

TEX Arrives for PCs

Now to discuss the implementations of TEX on PCs. The first point to note is that TEX is a standardized program, and hence the same input program should produce the same DVI output file on any TEX implementation. Thus the two PC implementations should be expected to have faithful adherence to the standard (otherwise they would earn demerits), and hence the two implementations must be judged on secondary characteristics. Interestingly, there are quite a number of such differences to be discussed.

PC TEX, from Personal TEX, Inc., became available in April, 1985. MicroTEX, from Addison-Wesley Publishing Company, gradually became available at about the same time. I have a late-model beta test version of this, which has been available to members of the American Mathematical Society since March, 1985; this latest test ver-

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sion is identical to the version placed on the general market in June, 1985. Both programs can be run with 512 kilobytes of RAM, but 640 kilobytes is strongly recommended. As some of the above discussion hints, the sophistication built into TEX makes it a very big program, and hence these large memory requirements. You will also need a hard disk, primarily to hold the raster files with font information (both implementations are initially designed to give output on the Epson FX, and RX, and MX series printers and their IBM adaptations running in graphics mode). MicroTEX also supports the Epson MX series and Okidata 92 and 93 printers. MicroTEX will use four megabytes of disk space and PC TEX will use six megabytes, if you choose to load all the fonts. MicroTEX comes on 8 DSDD floppy disks and PC TEX comes on 13 floppy disks. Neither program is copy-protected.

The current version of TEX is known as TEX82, and *The TEXbook* mentioned above is its official manual. The development of PC TEX and MicroTEX is described in short articles in TUGboat, vol. 6, No. 1. To understand this development, a little background is necessary. TEX82 is written in WEB, a language developed by D.E. Knuth which combines the features of PASCAL with those of a document formatter. Passing the WEB source code through a program called TANGLE produces properly written PASCAL code, while passing it through a program called WEAVE produces a TEX source file. It is the PASCAL source code that has generally been transported to different computers and modified as necessary to use the local PASCAL compiler.

PC TEX followed this path. Its developer, Lance Carnes, found it necessary to write a translation program to modify the TEX PASCAL source code produced by TANGLE so that it could be compiled by Microsoft PASCAL version 3.20. This first version contained some bugs and ran very inefficiently. There followed a period when Carnes carried out a lot of assembly language optimizations, thus decreasing the running time per page by a factor of two or three.

MicroTEX followed a somewhat different development path. Its developer, David Fuchs, wrote a translation program to convert the TEX PASCAL code produced by TANGLE to C so that it could be compiled by the Lattice C compiler. Again it was necessary to perform a lot of optimization.

The two versions of TEX perform at comparable speeds, taking about 20 seconds per page of average text to produce the DVI file. More difficult text, such as that contained in *The TEXbook* takes about 25 or 26 seconds per page. A future version of MicroTEX will use the new Microsoft C compiler and may process TEX documents about 20 percent faster, but this difference in speeds between the two versions of TEX is rather unimportant compared to the long times required to output a document on the Epson FX-80 dot matrix printer.

I have not discovered any bugs in either implementation of the TEX program. I have invariably found that both of them behave as described in *The TEXbook*. Because of the extensive development experience with the underlying PASCAL program, it is likely that they will both be remarkably free of bugs for the initial release of such a massive text formatting program.

TEX Output

We now move on to output processes. The fonts used by TEX are called "Almost Modern" in that they are produced by an interim version of another major program at Stanford called **METAFONT**. When the final version of **METAFONT** is available, the fonts produced by it will be called "Computer Modern". The basic design of a character using **METAFONT** is quite involved, but once the design has been made, different representations of the character in different fonts are produced by varying **METAFONT** parameters. Furthermore, the output from **METAFONT** can be matched to the characteristics of any raster output device, in order to compensate as well as possible for the course resolution of many output devices (such as dot matrix printers). A byproduct of running **METAFONT** is the production of a TEX Font Metric (TFM) file. This becomes a standard file and contains information about the height, depth, and width of each character in a font, as well as information which affects the relative spacing of certain pairs of characters, known as ligatures and kerning. This file is needed by TEX for every font which it is to use.

The actual raster description of the characters in a font is contained in a PXL (for pixel) file, and there is a standard format for these. This description is organized by horizontal rows of pixels, each a multiple of 32 bits long. PC TEX uses these files directly. MicroTEX has converted the PXL files to "EPF" files which are organized by columns that are more convenient to use with the moving head of a dot matrix printer, but a program has been provided to interconvert between PXL and EPF files. I have swapped PXL files between the two versions of TEX,

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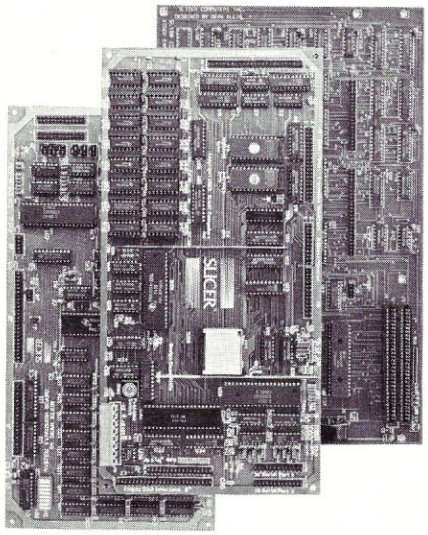

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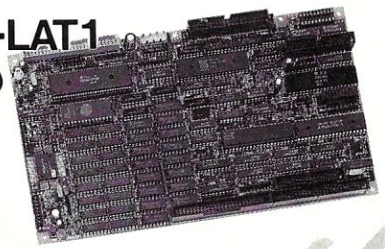

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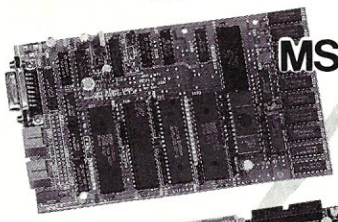

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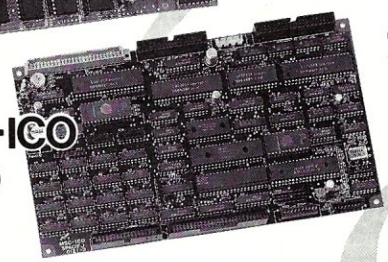

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and they work well with each other. However, the PXL files are not identical, and hence the fonts of the same name supplied by each vendor are derived from different sources.

This article is printed in 9 point type, for the most part using an Autologic APS-5 phototypesetter operated by Textset, Inc., from a DVI file prepared on an IBM XT emulator using PC TEX because of the availability of 9 point fonts, and proofed with an Epson FX-80+ printer. However, this particular paragraph has been prepared using a QMS Lasergrafix 800 printer, also operated by Textset, Inc. Like most laser printers, this one has a resolution of 300 dots per inch in each direction. Textset has several DVI-to-printer driver programs, and it is porting all of them to the IBM PC. This means that there will shortly be a choice of high quality output devices that can be driven to output DVI files from IBM XT/AT computers or their emulators. Textset also offers a semi-interactive TEX screen preview driver for Apollo and Sun workstations (which have high resolution graphics screens). PC TEX promises to provide such a screen driver for the IBM PC in the future.

It is also possible to use the Apple LaserWriter printer for output, and this paragraph has been so printed. In this case the printer is driven by the PostScript program developed by Adobe Systems of Palo Alto, CA. Textset and Adobe Systems are cooperating to prepare PostScript representations of the computer modern fonts and a TEX-to-PostScript translation program. The advantage of PostScript is that it can also be used for graphics output from the IBM PC, and this provides a practical method of merging graphics and text outputs, something that TEX cannot do alone. PostScript also supports the new QMS Lasergrafix 1200A printer.

In order to allow you to compare the output from the FX-80 printer for the two versions of TEX, I will switch in the next paragraph to 10 point type. First, however, you should see the output at 9 point from the FX-80, and this paragraph has been thus prepared using the 9 point roman font supplied with PC TEX. MicroTEX does not yet supply fonts in this size. The output can easily be read, but the letters are a lot fuzzier than was the case previously in this article. This is a combined result of the lower resolution of the FX-80 printer and of the larger dot size produced by the striking pins on that printer.

This is 10 point roman type supplied with PC TEX. The Epson FX-80 printer has a graphics resolution of 216 points per inch vertically by 240 dots per inch horizontally. Lance Carnes has told me that he used rasterized fonts from a 240 dots per inch vertical by 240 dots per inch horizontal resolution standard TEX distribution tape, so that the characters are technically ten percent too high. However, I do not find this at all bothersome.

This is 10 point roman type supplied with MicroTEX. In this case David Fuchs modified the parameters in METAFONT to produce fonts with the correct vertical and horizontal resolutions for the FX-80 printer, and he also slimmed the characters compared to the defaults used with the program. Thus it may be seen that this output has a somewhat more pleasing look to the eye (at least to my eye) than that shown above. However, it is not a practical solution to mix the fonts from PC TEX and MicroTEX, since the former characters to some extent look like boldface versions of the latter characters. Thus I recommend that either you should stick entirely to the more limited font set supplied with MicroTEX (to be expanded later), or if you now want the larger set of fonts supplied with PC TEX, you should stick entirely to that set since the fonts mix better with one another.

Fonts

Now back to the APS-5 phototypesetter. Let us see some of the available fonts in PC TEX. This font is roman, and it is available in 10 point type, 9 point type, 8 point type, 7 point type, 6 point type, and 5 point type. **This is boldface extended, and it comes in the same range of sizes.** *This is text italic, and it is available in PC TEX in sizes 7 through 10 points* and there is also an unslanted version available at 10 points. *Somewhat different is slanted type available in 8 through 10 points* ***together with a bold extended version at 10 points.*** I like this sans serif font very much, but it is only available at 10 points, **although a boldface extended** *and an italic version are also available,* and the monster 40 point version used

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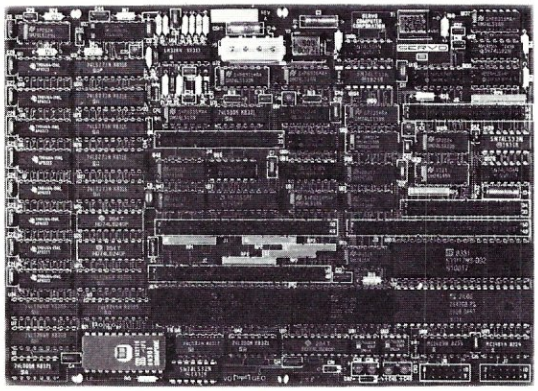

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for the title of this article is also sans serif. ALSO AVAILABLE, BUT ONLY AT 10 POINTS, ARE CAPITALS AND SMALL CAPITALS WHICH ARE USEFUL FOR SUBHEADINGS.

To see the effect of magnification, note that this is 10 point roman type; that this is the same at magstephalf, or 11 points; this is at magstep1, or 12 points; this is now at magstep2, or 14 points; at magstep3, or 17 points; and at magstep4, or 20 points. Only the more basic fonts are available beyond magstep1.

MicroTEX has only the 16 basic fonts mentioned near the beginning of this article, but they are all available through magstep4, and they come in two resolutions, at 240 dots per inch horizontally for Epson FX and RX types of printers and at 120 dots per inch horizontally for Epson MX type printers. With FX and RX printers you can use both sets of fonts to give three qualities of draft output and a final or full resolution output. The better the resolution, the greater the number of passes needed per line of output. With full resolution, 12 passes are needed for every 24 vertical dots of resolution, and this is agonizingly slow. PC TEX provides only 240 dots per inch horizontally for its fonts, so its draft mode is equivalent to the best draft mode in MicroTEX, and this draft mode is still painfully slow.

Within this box are shown the input instructions for the two paragraphs following the "Fonts" heading.

```
\leftline {\tenssbx Fonts}

\ninerm
\baselineskip=11pt
    Now back to the APS-5
phototypesetter. Let us see some
of the available fonts in \PCTeX.
This font is roman, and it is
available in {\tenrm 10 point
type}, 9 point type, {\eightrm 8
point type}, { \sevenrm 7 point
type}, {\sixrm 6 point type},
{\fiverm and 5 point type}. {
\ninebf This is boldface extended,
and it comes in the same range
of sizes.} {\nineit This is text
italic, and it is available
in \PCTeX\ in sizes 7 through
10 points} {\tenu and there
is also an unslanted version
available at 10 points.} {\ninesl
Somewhat different is slanted
type available in 8 through 10
points} {\tenbxsl together with
a bold extended version at 10
points}. {\tenss I like this sans
serif font very much, but it is
only available at 10 points,}{
\tenssbx although a boldface
extended}{\tenssi and an italic
version are also available,} and
the monster 40 point version used
for the title of this article is
also sans serif. {\tencsc Also
available, but only at 10 points,
are CAPITALS and small capitals
which are useful for subheadings.}

    To see the effect of
magnification, {\tenrm note
that this is 10 point roman
type;}{\tenrmhalf that this
is the same at magstephalf,
or 11 points;} {\tenrmone
this is at magstep1, or 12
points;} {\tenrmtwo this
is now at magstep2, or 14
points;}{\tenrmthree at magstep3,
or 17 points;}{\tenrmfour and at
magstep4, or 20 points.} Only the
more basic fonts are available
beyond magstep1.
```

I judge MicroTEX to have the better user interface, particularly for use with the FX and RX printers. It offers the user a wider range of options for outputting the text on the printer. Considering the terribly slow rate of output on these printers, there is a considerable advantage in the poorer quality draft modes used by MicroTEX. However, PC TEX offers many more fonts, and it offers a greater variety of macro packages, to be discussed next. Furthermore, the cost of MicroTEX is $495, while that of PC TEX is $279 plus $100 for the printer driver, called PC-DOT.

Macro Packages

Because of the exceptional richness of the control language of TEX, many typists called upon to type documents for input to this program have complained about the difficulty in finding the right control sequences to use to achieve various effects in the output. In particular, some of the fine points in the adjustment of horizontal and vertical spacing are hard to master for many people. This has led to the development of a number of macro packages which create specialized TEX'ing environments. In these environments a great many parameters which the user might want to adjust have been given values, and the novice is best advised not to try to change these until he or she understands enough about the fine details of TEX not to need the macro package. I have observed that experienced TEX users tend to build an input file of macros and definitions of control sequences and thus in effect to create their own macro packages fine-tuned to the particular formats that they find most useful. Thus it may be that you will be satisfied to use plain TEX and to find all the control sequences you need by thumbing through *The TEXbook*.

PC TEX supplies several of these macro packages. The simplest of these to use is an elaboration of plain TEX called "vanilla" TEX. There are a few differences between the plain and the vanilla styles of TEX, but these will not be of much concern. The principal purpose of the vanilla style is to provide control sequences that standardize the format of various features of a manuscript. For example, the control sequence `\title ...\endtitle` surrounding your title will take care of the font selection and positioning of the title on the page. Exactly how this is done for some constructs will depend on the details of the style file that is input along with the vanilla style file. PC TEX supplies style files for the preparation of letters, homework assignments, and the PC TEX manual itself.

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It is interesting to note that the TEX program has been adopted by the American Mathematical Society (AMS) as the text formatter to use for the preparation of papers for its journals, and in fact the logo TEX is copyrighted by the AMS to protect the name from being used with programs that do not faithfully incorporate all the standard features of the Stanford program. There is under development a macro package called AMS-TEX which will incorporate all the style rules for the AMS journals; preliminary versions of this exist on many mainframes and minicomputers. When the AMS releases the final version of this package, it will be supplied to purchasers of PC TEX.

However, the biggest macro package supplied with PC TEX is a preliminary version of LATEX, created by Leslie Lamport. This is a document processing system, and the macro package is *huge*. A full 640 kilobytes of RAM is needed in order to run LATEX, and even then it is necessary to be very selective in choosing the fonts to be used with the package. For example, as the package is supplied with PC TEX, sans serif and capital and small capital fonts are not selected. I went into the macro definitions and changed some of them to select these two fonts, and im-

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mediately received an error message to the effect that there was not enough room for these fonts. This has the odd result that the distributed version of LaTeX cannot even print out its logo properly, with a small capital 'a' in the second position. In order to enable these fonts, I had to deselect others (in particular, I deselected the typewriter type fonts). Such modifications will not be easily done by those unfamiliar with the fine details of TeX control sequences.

LaTeX not only establishes style environments for many features of a document, but it is capable of doing a lot of the tedious bookkeeping that makes life miserable for authors of books and extensive manuscripts. This includes not only management of the positioning of figures and tables, but also the creation of a table of contents, an index, a glossary, cross references, and bibliographies and citations. One can even use LaTeX to create simple diagrams incorporating boxes, circles, ovals, and interconnecting lines, both curved and straight, using some special LaTeX fonts and positioning commands. This facility is not very easy to use in its present form. In general, however, LaTeX is a very powerful tool.

What of the future for TeX on PCs? Addison-Wesley expects to add enhancements to MicroTeX, including more fonts, drivers for additional printers, the LaTeX macro package, and some related software and books. Personal TeX expects to add such enhancements as a preview screen driver, drivers for various laser printers and other output devices, and various additional customized macro packages. For both vendors the development of various output drivers by Textset may provide some of these needs, but I expect that other development of proprietary drivers will also take place. In particular, we can shortly expect to be able to merge graphics with TeX output. What we are seeing here is the establishment of a very sophisticated personal publishing capability. It is to be hoped that the ability to do sophisticated symbol design will also be established for PCs, probably by porting **METAFONT** to PCs.

The documentation provided by the vendors addresses quite different objectives. Since MicroTeX is just plain TeX, it relies entirely on *The TeXbook* to provide the user information about using TeX, and it provides only a rather slim manual describing how to use the MicroTeX implementation of the program and the specialized DVI-EPS output program which prints a DVI file on the Epson printer. This manual is well done. On the other hand, PC TeX assumes that you may want to use one of the macro packages because you do not wish to plumb the intricacies of *The TeXbook*, so in fact two manuals are provided. The first manual gives a simplified introduction to using TeX in the plain and vanilla versions, and describes some of the features of AMS-TeX and LaTeX. This manual was prepared by Michael Spivak, author of the vanilla style and of AMS-TeX. This manual is good for its intended purpose, but the description of how to use the DVIEPS output program is too skimpy, and installation directions are contained on separate sheets. The second manual included with PC TeX is the preliminary manual for LaTeX, written by Leslie Lamport but not especially for use with PC TeX. We are warned that it is still preliminary, and there are significant changes described in a section of errata. The final LaTeXmanual will be published by Addison-Wesley within a year.

Summary

Both MicroTeX and PC TeX are very reliable and sophisticated packages which require the full capabilities of a PC with a hard disk. In my opinion the user interface of MicroTeX is somewhat preferable, and it has been better adapted to use with the Epson series of FX and similar printers. Nevertheless, I tend to use PC TeX more because of the availability of additional fonts and the macro packages. Its lower price is also an important consideration. The Epson FX-80 is an unfortunate output device because it is so painfully slow, and I strongly advise potential users of TeX on PCs to consider using a Toshiba printer or an Epson LQ-1500 printer, which each have a graphics resolution of 180 dots per inch in each direction, which are much faster, and for which Personal TeX will shortly be able to provide drivers (note that the Toshiba printers can only be stepped vertically in units of 1/48 inch, so some compromises will be necessary in designing their drivers). An even better solution is to get your own laser printer, since there will also shortly be drivers for a variety of these, from Textset and possibly other vendors.

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TeX Users Group, c/o American Mathematical Society, P.O. Box 6248, Providence, RI 02940.

A.G.W. Cameron is Professor of Astronomy at Harvard University and is a member of the Harvard-Smithsonian Center for Astrophysics. He is at 60 Garden Street, Cambridge, MA 02138.

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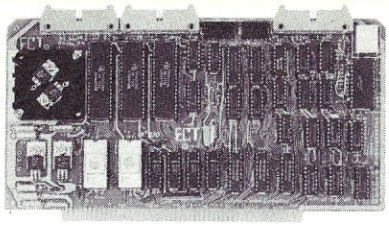

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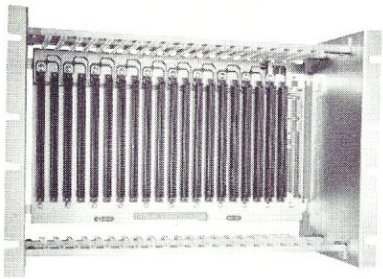

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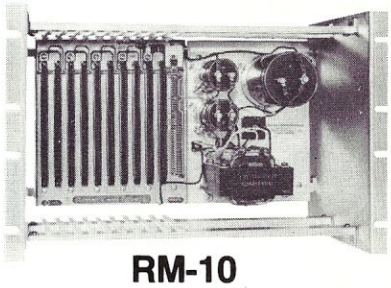

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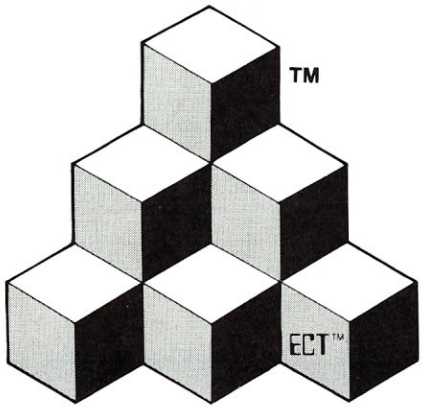

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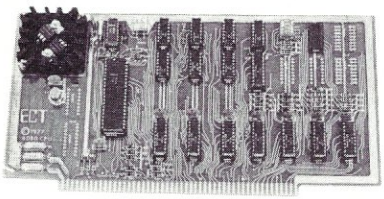

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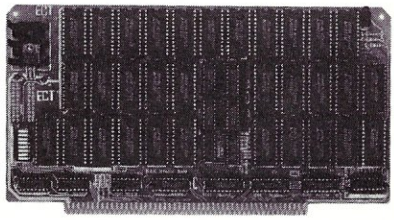

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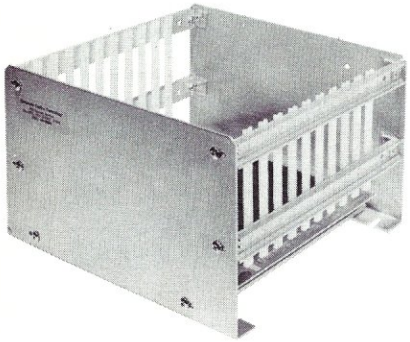

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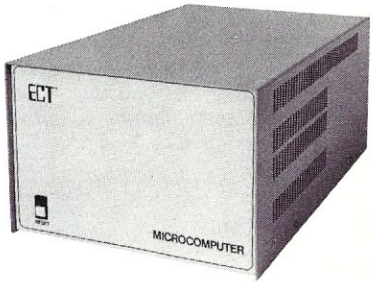

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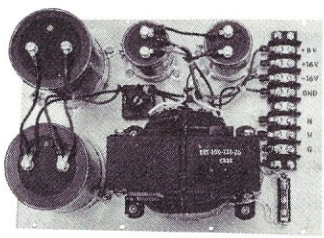

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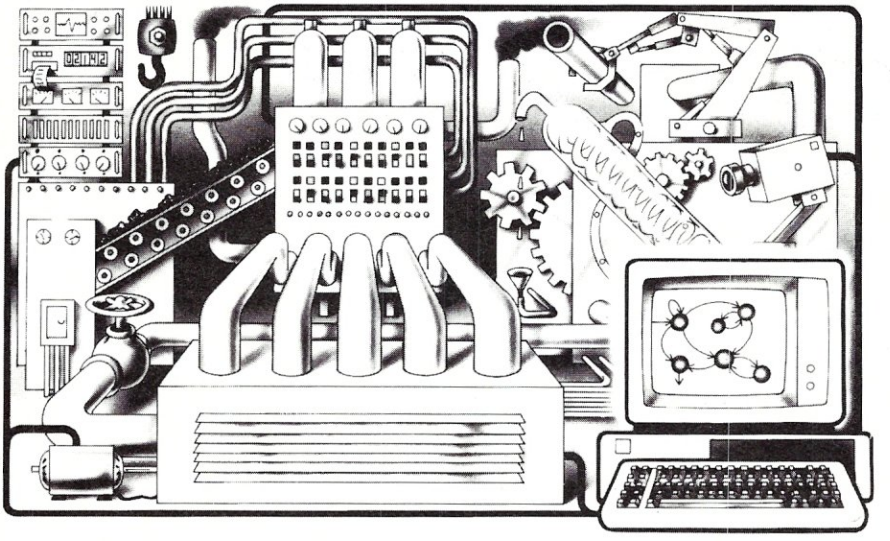

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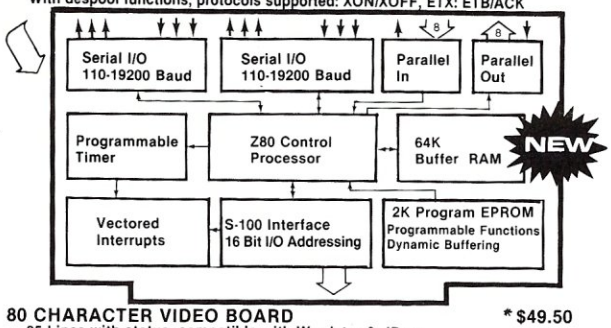

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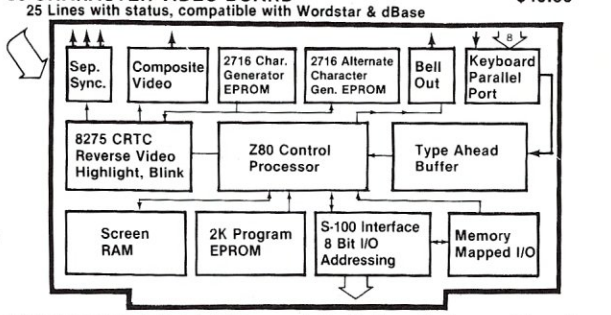

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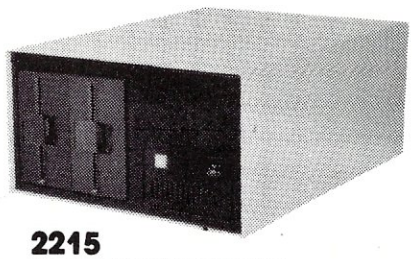

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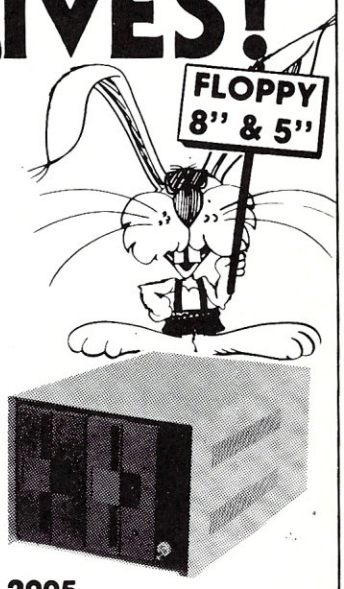

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The UNIX File

by Ian F. Darwin

The UNIX File discusses the UNIX system. If you have comments or questions about UNIX or this column, please write to Ian Darwin at Box 603, Station F, Toronto, Ontario, Canada M4Y 2L8. If you have UNIX mail access to the uucp network, you can contact me at "ihnp4!darwin!ian". I can't always answer immediately, but I will get back to you (electronic mail gets answered first!). And I'm glad to hear from readers with comments on this column or reactions to particular UNIX systems or products.

In this issue I haul yet another little-known but useful UNIX program out of the hat. If you need to join the UNIX network for *uucp* mail or news, I give some information about that.

MACRO PROCESSING

Have you ever had to maintain several versions of the same file? It might be to prepare a document for several audiences, or a program for use on several similar computers - like UNIX variants. In the last issue I showed the use of *awk* on files organized by columns. The example used was a name-and-address database organized by columns (column 1 of each record is surname, column 2 is given names, etc.) also used for Christmas card lists, telephone list, etc. Now let's turn to files made up of lines with no common organization from one line to the next. If you use more than one UNIX system on a regular basis, for example, you have the problem of keeping your *.profile* (or *.cshrc*) files in synch with each other. (The *.profile* or *.cshrc* file is a series of commands to 'customize' a system). These *.profile* files are similar, but with variations for the different UNIX versions, different location of key programs on systems you don't control, etc. You might want the line

```
NAME="Archie Bunker"; export NAME
```

in all versions, but at one site you might need

```
PATH=/bin:/usr/bin:/usr/lbin:.;export PATH
```

while at another you might want

```
PATH=/bin:/usr/bin:/usr/ucb:.;export PATH
```

I will show how to keep these variants in synch, so that if you add or change a line it only needs to be changed in one place, instead of dialing into 3 or 4 (or a dozen in my case) different UNIXes and changing each with the editor.

Awk could certainly be used, but it's not the best tool for the purpose. Most of the lines in *.profiles* are the same in all versions; we want a tool that passes most of its input unchanged, and processes some 'control lines'. One heavily used utility that does this is the C preprocessor, *cpp*. But the system developers advise us, in the System V user's manual, to "See *m4*(1) for a general macro processor."

M4 is indeed "a general macro processor", used for massaging programs in several systems. *M4* is similar to the macro processor in the *Software Tools* book by Kernighan and Plauger. In the next few paragraphs I'll talk about using *m4* in the maintenance of variant files such as differing *.profile* files.

M4 works by reading an input text, breaking it up into 'tokens' or words, processing any tokens that turn out to be 'macros', and printing the result. If no special tokens or 'macros' are found, then *m4* will just copy its input to its output.* So if you just type the command *m4*, and type a few lines of text from your terminal and an EOF, you should see the text echoed back at you. Try it!

The three most common macros are *define*, *ifdef* and *ifelse*. *Define* makes a new macro, or gives a new word a new value. *Ifdef* executes one of two alternate statements based on whether a given macro is defined or not. *Ifelse* compares two defined words for equality, and executes one of two statements based on the result. Listing 1 is a quick example.

The first line defines a new word called 'System' and gives it the value "UNIX V.2". The 'ifdef' checks to see if 'System' is defined; if so the first substatement 'Environ ment is System' is done, otherwise the second ("Environ-

---

* Alas, the open and close quotes are also special to *m4* so you have to change the processor's idea of quotes to use *m4* on conventional text.

LISTING 1

```
define(System,UNIX V.2)
ifdef(`System',Environment is System,Environment is OTHER)
ifelse(System,UNIX,Version is System,Version (System) is not known)
```

LISTING 2

```
changequote([,])dnl()
# this .profile is machine-generated from an M4 script. do not edit!
DOTFILES=yes export DOTFILES
EDITOR=/bin/ed export EDITOR
ifelse(SITE,darwin,INDEX=$HOME/doc/bib/INDEX export INDEX,[dnl()])
ifelse(SYSTEM,USG,MAIL=/usr/mail/ian,MAIL=/usr/spool/mail/ian) export MAIL
MAILER=yamail export MAILER
NAME="Ian F. Darwin" export NAME
include(path.SITE)dnl()
PS1="_PS1% " export PS1
[eval] `tset -sQ -m 'dialup:?vt100'
```

LISTING 3

```
define(_PS1,home)define(SITE,darwin)dnl()
define(NEWSTYPE,UNSW)dnl()
define(SYSTEM,USG)dnl()
define(MDA,SENDMAIL)dnl()
define(SIGNOFF,"echo bye now")dnl()
```

ment is OTHER'') is run. In this example, since it's clearly defined by statement one, the first alternative is taken, and substitution is done. Thus the second statement will print out

```
Environment is UNIX V.2
```

Note that quotes are not used on the 'define', are used on the 'ifdef', and are not used on the 'ifelse'. The quoting rules for *m4* are simple but take getting used to. Note also that unlike many macro processors, *m4* does not require the macro names to be prepended by a special character such as '$' or '#' or ' ' where they are used in the text.

The third statement, *ifelse*, compares two strings and does one of two other statements. If 'System' and 'UNIX' are the same, we should see

```
Version is UNIX
```

Since they're not equal ('System' is 'UNIX V.2', not just 'UNIX'), we will instead see

```
Version (UNIX V.2) is not known.
```

With these keywords in hand, we can look at an example. Listing 2 shows the first few lines of 'gen.m4' used to generate my *.profile*s.

The first line 'changequote' is necessary because both *m4* and the shell command language use the same quote characters; square brackets are unlikely in a *.profile* file so I used them. The next line is just a shell comment; *m4* passes The next line ('EDITOR...') sets up an environment variable to tell mail and news programs what line editor I use; it too has no special meaning to the macro processor. The next line, however, is a macro, the 'ifelse' function described earlier. It says, roughly, that if we are generating a file for site 'darwin', emit the INDEX= environment variable. The 'dnl()' is a special *m4* macro that deletes everything up to the newline; it is optional but makes the output look neater. The 'ifelse' puts out a MAIL= environment variable to handle the differences in mailbox location among UNIXes. Note that you can mix macro calls with normal text on the same line to avoid having to repeat something in both alternates in an 'if'. Then we have two more environment variables followed by an *m4* macro 'include' that copies an input file. Because PATH is so wildly variable, I keep each one in a separate file; this is only one of several ways of organizing this data. The filename evaluates to 'site.darwin'. The next line sets up an environment variable that sets the prompt string to the shell. Now the main file shown couldn't just say

```
PS1="PS1 "; export PS1
```

and have PS1 set in the site file to (say) 'what next?', since this would evaluate the line as

```
what next?="what next?";export what next?
```

which makes no sense. I could have written the line using the *m4***quotes around PS1 where it is used as the environment variable name, but it seemed easier to use a slightly different name for the** *m4* variable (underscore '_' can be used as an alphabetic in names).

The last line prints 'eval'; since 'eval' is a built-in macro it must be quoted.

This file is run with a 'header' file for each site. I have a series of files named 'sitename.m4', i.e., for my system the file is called 'darwin.m4'. This file initializes variables, as shown in listing 3.

To invoke each of these site-dependant files in turn, I have a *make* rule of the form

```
m4 gen.m4 darwin.m4 >$@
```

to build a series of profile files, customized for the sites I use, and another rule to send them out via electronic mail. I won't show these here, since I've covered *make* in previous columns.

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I've used only a small part of *m4* here; in particular I've not even used any macros with parameters, nor have I used the 'diversion' facility for changing the order of input, several of the string-handling and error-message facilities, or other functions. These are described in the *m4* manual; with a full-scale example in hand you should be able to appreciate what the program can do.

GETTING ON THE UNIX NET

Many readers with small UNIX boxes ask how to join the UNIX Network. The net is a voluntary cooperative, not a club. There are no membership dues, no formal organization, and few rules. It is simply a loose federation of computer sites with a common interest in UNIX and running a common set of communications programs. The main sets of programs are *uucp*, *mail* and *news*. The first is the lower-level communications programs that allow one machine to communicate with another. *Uucp* differs from programs like MODEM7 or Kermit that are generally meant for direct use sitting at a terminal directing the programs. *Uucp* is a 'spooling system', that is, requests are put in a spool directory by *uucp* (for file copies) or *uux* (for remote command execution) either directly or by one of the higher-level programs. Another program *uucico* connects the dial-out modem to the other computer and exchanges files. A third program *uuxqt* runs commands received from other sites.

Mail sent from one site to another using this mechanism causes the mail system to invoke *uux* to schedule the running of an 'rmail' command on the next machine in the path; this machine in turn strips its name off the path and passes the mail (again via *uux*) to the next machine in the path.

News is similar, but news propagates out "in all directions" from the originating site. One site will send its news to a number of neighbor sites, each of which will send it to more neighbor sites. Some sites have long distance links, so news works its way across the continent and around the world in a day or a few days.

Most UNIboxes are distributed with mail software but without news. To get started with mail, all you need is a connection to any site that is connected to other sites. You exchange connection information ('L.sys' info) with the site administrator. Then you may need to debug the uucp connection; that's gist for another column.

When you have gotten your uucp connection going, you can usually exchange mail with your neighbor site, and with any sites that they talk to, and any sites that *they* talk to, and so on. All you need to do is specify the routing. The syntax is simple; for mail you just say

```
mail mach1!mach2!mach3!username
```

where mach1,...are the names of the machines, starting from your nearest neighbor. Username is the recipient's login.

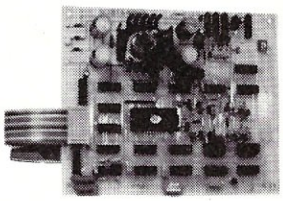
Exchanging news is more complex. You need to get the latest news software (usually from a large neighbor site), and configure it for your site. The documentation for this process is longer than my column; basically you customize the Makefile to describe your system in detail and then type *make*. Your neighbor site will be familiar with the variant of news that they have given you, so they can usually give you minimal assistance (hint: don't wear out your welcome by asking questions that are in the documentation).

Now you have the equipment and the *uucp* and mail software and you want to get started. All you need is the name and contact person at a local site. Try your local university computer center first. But if they aren't there or can't help, drop me a line and I'll try to put you in touch with network sites in your area.

That's all for this month. I welcome letters and electronic mail on these and other topics, especially suggestions for future columns. Cheers!

CP/M, MS-DOS EPROM PROGRAMMING SYSTEM

2708
2758
2516
2716
2732
2764



2732A
2764A
27128
27128A
27256
27CXX

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- COMPARE EPROM WITH RAM
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You do not have to copy software which has appeared in MS/J when you can get it on disk from a local user group or RBBS system. For example, you will find most of our software availble for downloading on Dave Carroll's "High Sierra RBBS" system, (209)296-3534.

Or, you can obtain the software directly from Micro/Systems Journal. We have put the software from all of our 1985 issues on disk. It is available in several different disk formats including 8" SSSD-CP/M, 5" IBM-PC (MS-DOS & CP/M-86), KayPro-II,4 & 10. Other formats are also available; please check with us before ordering.

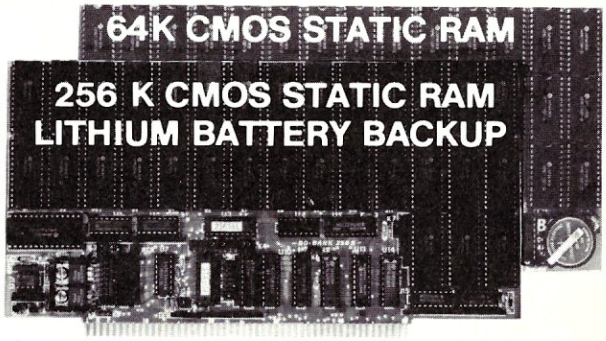
The charge is $12 (including shipping) for U.S., Canada & Mexico. Other foreign add $5 (shipped via air).

The following is the contents of the disk:

Article Title	*Author*	*DOS*	*Vol/#*
Bringing Up CP/M-Plus	Kolansky	CP/M	1-1
Extended SD Disk Storage	Howard	CP/M	1-1
Assembly Language Extensions-MBASIC	Kreymborg	CP/M	1-1
Logical Name Translation	Brewer	CP/M	1-1
WS Translation (C)	Libes	CPM/MSDOS	1-2
WS Translation (TurboPascal)	Carroll	CPM/MSDOS	1-2
C & Godbout Disk 1 Controller	Heyman	CP/M	1-2
Loadable BIOS Drivers	Sondgeroth	CP/M	1-2
File Dump Utility (TurboPascal)	Carroll	CPM/MSDOS	1-3
Structured Programming with M80	Quinn	CPM	1-3
Local Variables In Forth	Reno	CPM/MSDOS	1-3
TurboPascal Install	Carroll	CPM/MSDOS	1-4
Who Prints On Printers(CCP/M)	Soya	CCP/M	1-4
Interrupt Borrowing (TurboPascal)	Davis	MSDOS	1-4
Bringing Up CP/M-68K	Calaway/Hill	CPM	1-5
Intersystem Processing(TurboPascal)	Volpe	CPM/MSDOS	1-5

Micro/Systems Journal, P.O. Box 1192, Mountainside, NJ 07092

HIGH PERFORMANCE RAM



✓ COMPARE

	8/16 BIT DATA	Bank Selection MPM, OASIS, CROMIX-D	10 Megahertz Speed	Software Write Protect	Battery Backup Option
Compupro Ram 22	✓	NO	✓	NO	NO
Octagon 256K	✓	NO	✓	NO	NO
Cromemco 256KZ II	✓	NO	NO	NO	NO
Dynamic Boards	✓	✓	NO	NO	NO
BG-Bank 256S	✓	✓	✓	✓	✓

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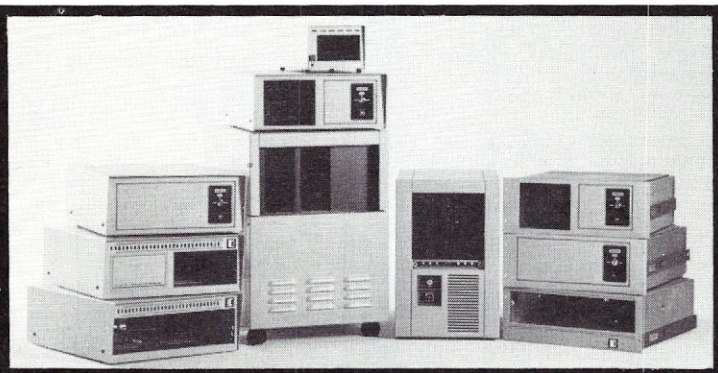

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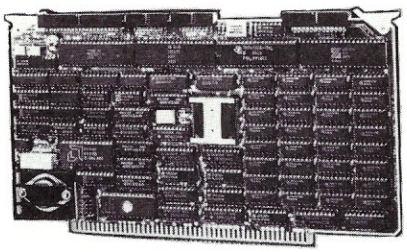
New Products

When contacting vendors please mention that you read about them in Micro/Systems Journal.

S-100 PRODUCTS

80186 SINGLE BOARD COMPUTER

Intercontinental Micro Systems (ICM) has introduced the CPZ-186, a single board S-100 computer utilizing the Intel 80186 microprocessor running at 8Mhz. The board contains 256K of dynamic RAM expandable to 512K or 1Mbyte. The are two serial I/O ports as 20 parallel I/O lines (16-data and 4-handshaking) and a floppy disk controller to support up to 4 drives. Baud rate is software controlled up to 1Mbaud. The CPZ-186 has memory management for up to 4Mbytes on 256K relocatable pages. There is a 2-channel DMA controller and 18 channels of vectored priority interrupts.

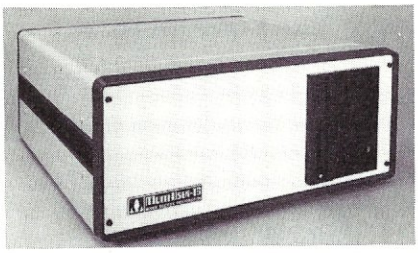


The CPZ-186 can be used as a single board computer or as a master (file server) in a local area network. Up to 4,000 users can be linked to up to 255 file servers, in combination, via ICM's ARCnet hardware and TurboLAN software. Users can be IBM-PC's, AT's, Jr's, PC compatibles, S-100 systems etc. A multi-user system can be built using Software 2000's TurboDOS and TurboDOS/PC with CP/M, MP/M, MS-DOS, CP/M-86 and PC-DOS compatibility.

The CPZ-186 lists for $1495 and includes RS-232 and floppy disk controller personality boards. For further information contact: Steve Rasmussen or Don Shulz, Intercontinental Micro Systems Corp., 4015 Leaverton Court, Anahiem CA 92807; (714)630-0964.

MULTI-USER/MULTI-TASKING SYSTEM

Inner Access Corp. has introduced the "MultiUser 16", an S-100 based multi-user/multi-tasking system utilizing the "Mirage" operating system, that is widely used in Europe. It uses the Motorola 68000 processor (68010 optional), supports 16 users (expandable to 64), 2Mbytes of RAM (expandable to 16Mbytes), 40Mbyte hard disk unit (expandable to 1Gigabyte), 1.2Mbyte floppy disk unit, operates at 8Mhz (10Mhz optional), and has an 8-slot motherboard (20 slot optional). Options include a 60Mbyte tape backup unit, language packages (Extended BASIC, PASCAL, APL, FORTRAN77, and FORTH83) and many utility packages.



The price is $6775 to authorized dealers and VARs. For more information contact: Gary Feierbach, Inner Access Corp., Box 888, Belmont CA 94002; (415)591-8295.

MEMORY UPGRADE PAL FOR HEATH/ZENITH Z-100

Software Wizardry has introduced the RamPal-100 memory upgrade modification for Heath/Zenith Z-100 dual processor systems. The RamPal-100 is a set of 5 replacement PAL (Programmable Array Logic) IC's which replace the PALs on the current motherboard. It enables the user to use the new 41256, 256K-bit dynamic RAM chips to extend the system's memory up to 768K on the motherboard. Systems with motherboard assembly numbers of 181-4918 or higher can be upgraded without hardware or software mods. Others may require modifications; consult the supplier or your dealer (most Heath/Zenith Electronic centers carry the upgrade).

The RamPal-100 lists for $79.95. For further information contact: Software Wizardry, Inc., 1106 First Capitol Drive, St. Charles MO 63301; (314)946-1968.

Z-80 8Mhz SLAVE PROCESSOR CARD

Earth Computers has introduced TURBOSLAVE I, a Z-80 based S-100 slave processor card operating at 8Mhz. The card is intended to be a user processor under the TurboDOS operating system or as a coprocessor under other operating systems.

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The board contains 128K of RAM, two serial ports, and a mapped FIFO port for master-slave communications. It also contains on-board diagnostics, parity and monitor ROM to aid in initial loading. The board is compatible with S-100 systems built by North Star, I.M.S., Advanced Digital and Musys.

The TURBOSLAVE I lists for $595. For more information contact: Earth Computers, Box 8067, Fountain Valley CA 92728; (714)964-5784.

OTHER PRODUCTS

DATA ACQUISITION/CONTROL SYSTEM

Starbuck Data Co., 225 Crescent St, Waltham MA 02154 (617-899-8629) has introduced a low-cost programmable 8-channel, 12-bit data acquisition and control system that interfaces to any computer via an RS-232 port. The unit also features a real-time clock, pulse counting to 4500/minute, event timing to 23usec, 24 addressable I/O channels, and triggered and timed data logging modes. The unit is microprocessor controlled and can communicate at up to 19,200 baud. Price is $690.

THE SOFTWARE DIRECTORY

When contacting software publishers please mention that you read about them in Micro/Systems Journal.

Program Name: WRITE-HAND-MAN
Requirements: CP/M 2.2, Microsoft M80 or compatible assembler.
Minimimum Memory: takes 5K from TPA
Language: Assembler
Description: Make notes, look up phone numbers, make appointments or do terminal emulations without leaving application program. Single keystroke opens a window on screen to select function you want. When finished return to program you were running.
Price: $49.95 8'' SD and NorthStar 5'' DD, other 5'' formats add $5.
Publisher: Poor Person Software
3721 Starr King Circle
Palo Alto CA 94306
(415)493-3735

Program Name: F77L
Requirements: MS-DOS, 256K RAM and 8087 coprocessor
Description: Complete implementation of ANSI FORTRAN 77 standard. In addition to 6 types required by standard has LOGICAL*1, REAL*8, INTEGER*2 and COMPLEX*16. Has many IBM-H features including $ in a name, 9 character names, and initialization in type commands. Optional checking for subscript, subprogram class, argument and alternate return count. Execution error messages include text and subprogram/line-number traceback. IEEE Standard Floating Point arithmetic. Hollerith constants supported. Optimized object code for high-speed execution. Source-On-Line debugger and Lattice-C compatibility. Includes 250 page manual, customer telephone support and newsletters.
Price: $477
Publisher:
Lahey Computer Systems Inc.
31244 Palos Verdes Drive West, Suite 243
Rancho Palos Verdes CA 90274
(213)541-1200

Program Name: XPD
Requirements: Xenix System (Tandy, IBM-PC/XT/AT, etc.)
Description: Directs printer output to console or to any port. Provides selective or batch print queueing, printer-related attributes (e.g. font size and style and special codes).
Price: $250
Publisher: Telexpress Inc.
Box 217
Willingboro NJ 08046
(609)4900

Program Name: PLUTO BASIC
Requirements: CPM-80 or MS-DOS
Description: Interpreter for MAI/Basic Four and Science Management Corp. Business Basic programs. Designed for a multi-user environment it has file locking, indexed, direct, sort and host system serial text files.
Price: $695 (CP/M- KayPro-10 version); $595 (MS-DOS version)
Publisher:
Southwest Data Systems Inc.
3017 San Fernando Blvd
Burbank CA 91504
(818)841-1610

Program Name: MASTERFORTH
Requirements: CP/M-80, CP/M-86 or MS-DOS
Description: Implementation of Forth language including screen editor, debugger, relocatable utilities, and transient definitions. Matches Forth-83 standard as described in ''Mastering Forth'' (included in package). Several optional extensions available.
Price: $125
Publisher: Micromotion
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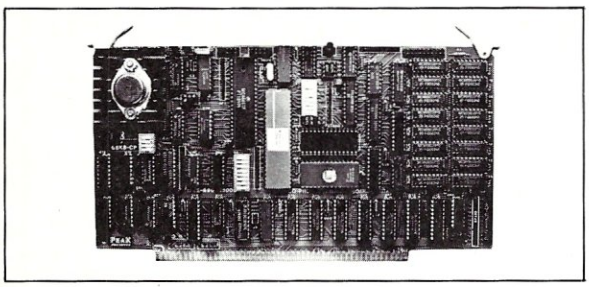
(213)821-4340



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Peak Electronics' 68K8-CP is a high performance processor card designed to function as one of several CPU elements within a multi-processor S-100 system. This card features the MC68008™ (8-bit object code compatible version of the industry renowned 68000), up to 512K bytes of RAM and 128K bytes of EPROM, two serial ports and a parallel printer port.

The true power of the 68K8-CP card is shown with its ability to be plugged into any existing S-100 system running CP/M®-2.2 and to be running CP/M-68K within minutes without any change in existing hardware or software. This card does not replace your current processor. All of the original system's devices (RAM, disks, and other peripherals) are immediately available to the user of CP/M-68K, files can be accessed by whichever operating system is currently active.

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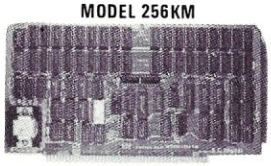
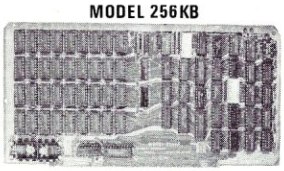


MODEL 256KB



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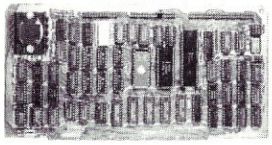
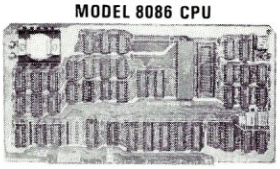


MODEL 8086 CPU



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MAY/JUNE 1985 (Vol 1., No. 2): Build an S-100 to PC-Bus Converter, Interfacing to MS-DOS Part-1, Loadable Drivers for CP/M2.2, Roll Your Own PC-Clone, Bringing Up ZCPR-3, C & Godbout Disk-1 Controller, Writing Translation Programs in C and Turbo Pascal; REVIEWS: 16-Bit Lisp & ProLog-Part II.

July/August 1985 (Vol 1., No. 3): Structured Programming With Microsoft M80 Assembler, Local Variables In Forth, Interfacing to MS-DOS Part-II, Data Translation with Turbo Pascal, Implementing Sets with Bit Operations in C, A Unix Mail List System; REVIEWS: Scientific & Technical Word Processors - Part I, Macrotech MI-286 S-100 CPU Card, Slicer System, Concurrent PC-DOS, Concurrent PC-DOS, Coherent Operating System.

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1984

AUGUST: Intro to Local Area Networking; Graphics Subroutines in C For NAPLPS; Using YACC, MAKE and Prolog under Unix; Multiprocessing on S-100; Using Unix Sort, ciphers and enhancements; REVIEWS: TurboDOS, NCR-PC, MindSet-PC, Adding TurboDOS to NorthStar System, Leverage DBMS for Unix.

APRIL: Unix Software Directory; Upgrade NorthStar ZPB; MS-DOS 2.0 Overview - Part 2; S-100 Phantom & Bank Selecting; Upgrading FIG Forth; REVIEWS: UniPlus+, Informix, DRI-C.

FEBRUARY: Using WordStar to Create Mailmerge/DBase-II files; Moving data files between CP/M software packages; Datestamp DBase-II; CP/M 2.2 Deblocking; Building S-100 diagnostic hardware; Enhance CP/M+ with RSX; REVIEWS: DBase-II, S-100 Mainframes, DRI Display Manager, AutoDex, Turbo Pascal.

JANUARY: Enhancing MP/M - Part 1; Installing MP/M; Add Concurrency to MP/M; Two Users on CP/M; Relocating Assemblers & Linkage Editors - Part 3; S-100 Wait States; REVIEWS: MP/M-8/16, ProComp-8, Paragraphics Game Board, ProLog.

1983

DECEMBER: CP/M Software Directory; A Debug Subroutine; Implement IOBYTE on North Star; Floppy Disk Problems; Improve Trig Functions in CBasic-80; Build Cheap S-100 Memory; Extended Memory Management; CP/M-86 BDOS Calls; REVIEWS: XLISP, LISP/80, TLC LISP, APC Basic, Microdynamics S-100 EProm Programmer, Ackerman S-100 Digital Synthetalker, Digital Research 16K & 32K S-100 Memory cards.

NOVEMBER: Intro to 80286, 68000, and 16032 Microprocessors; Intro to Local Area Networks - Part 2; Extended Memory Management for older S-100 Systems; Notes on Microsoft Fortran-80; Building S-100 Parallel Ports; REVIEWS: CompuPro CPU-68K, System 8/16, Xenith Z-100, Nevada & Ellis Computing Fortran.

OCTOBER: Intro to Local Area Networks, Part-1; Build Low-Cost LAN; Build S-100 Bubble Memory Card; Use Radio Shack Model 100 portable with a CP/M system; Write Menu-Driven Utility for Setting Printer Options; North Star Improvement; True Z-80 Random Number Function; Hide Code in Basic REM statements; Machine Code loader for MBasic; Increase Single-Density Disk Formatting; Relocating Assembler & Linkage Editors, Part-2; Run MX-80 with North Star; User Group Directory; CP/M-86 Versus CP/M-80; REVIEWS: CP/NET, QBAX, S-Basic.

AUGUST: XERA Program; Logging-On CP/M; WordStar Date/Time Patch; Find Location of Variable in NorthStar Basic; Prevent System Crashes During Warm Boot; Enhance Spreadsheet Print Files; Plotting Package-Part 3; Run WordStar under TP/M; 50-line Text Formatter; Using the LU Utility; User Areas under CP/M; REVIEWS: Stiff Upper Lisp, MuLisp-80, Supersoft Lisp, Cromenco C-10, Access Manager, Fancy Font, Computime SBC-880 S-100 card.

JULY: Using RCPMs; RCPM Directory; PIP Data Between Computers; Toward Smarter Modem Programs; Interface MX-80 via Parallel Interface; Digital Audio On CP/M System; Customize CP/M CBIOS; Plotting Package Part-2; REVIEWS: DRI PL/I-86 and PL/I-80, S-100 PMMI MM-VT1.

JUNE: Plotting Package Part 1; Drive HP Plotter; Laboratory Graphics Applications; Console Keypressed interrupts; Cutomize Wordprocessor Keyboard; WordStar Patch hor H-19/Z-19 Terminal; Relocatable Code; REVIEWS: Graftalk, JES S-100 Graphics Controller, ZCPR2.

1982

NOVEMBER/DECEMBER: CP/M Vs MS/DOS; CP/M-86 Vs MS-DOS; Intro to ADA Part 2; Virtual Disk for NorthStar; CP/M Program Auto-execute; Macros & Macro-Assemblers; REVIEWS: Janus, Aztec-C, C/80, Morrow S-100 M26 Hard Disk System, Teleram S-100

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MAY/JUNE: Intro to DBMS; Three ways to implement a mail list; Cursor Addressing; Structured Programming in Basic; Replacement for CP/M Submit; CP/M Disk Directory & Table Secrets; Mods for SDS VDB-8024; Run NorthStar Basic with CP/M; REVIEWS: DataStar, MDBS, TIM, Mince, ZDM.

NOVEMBER/DECEMBER: Introduction to the C Language, Virtual Segment Procedures, Little-Ada Part-II, A Disk Alignment Routine, Northstar DOS/BIOS Directory & File Conversion using UCSD Pascal; REVIEWS: BDS-C, Small-C, Tiny-C and Whitesmiths-C; Tarbell Double-Density Disk Controller

1981

JULY/AUGUST: 16-Bit Disk Operating Systems; Input Queuing For NorthStar; Variable Speed Automatic Slow Step; Build S-100 Clock/Calendar Card; REVIEWS: TEC-86 System, Seattle Computer 8086 System, AlphaMicro, Godbout Dual Processor, CP/M-86, Televideo 920-C Terminal.

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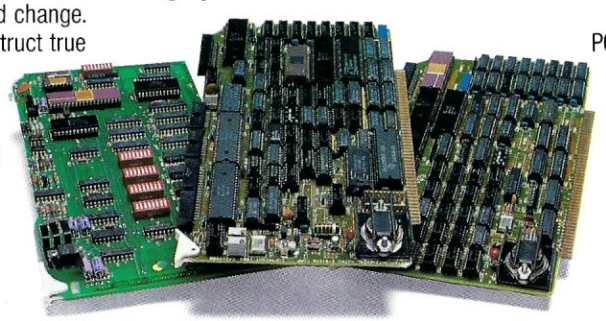

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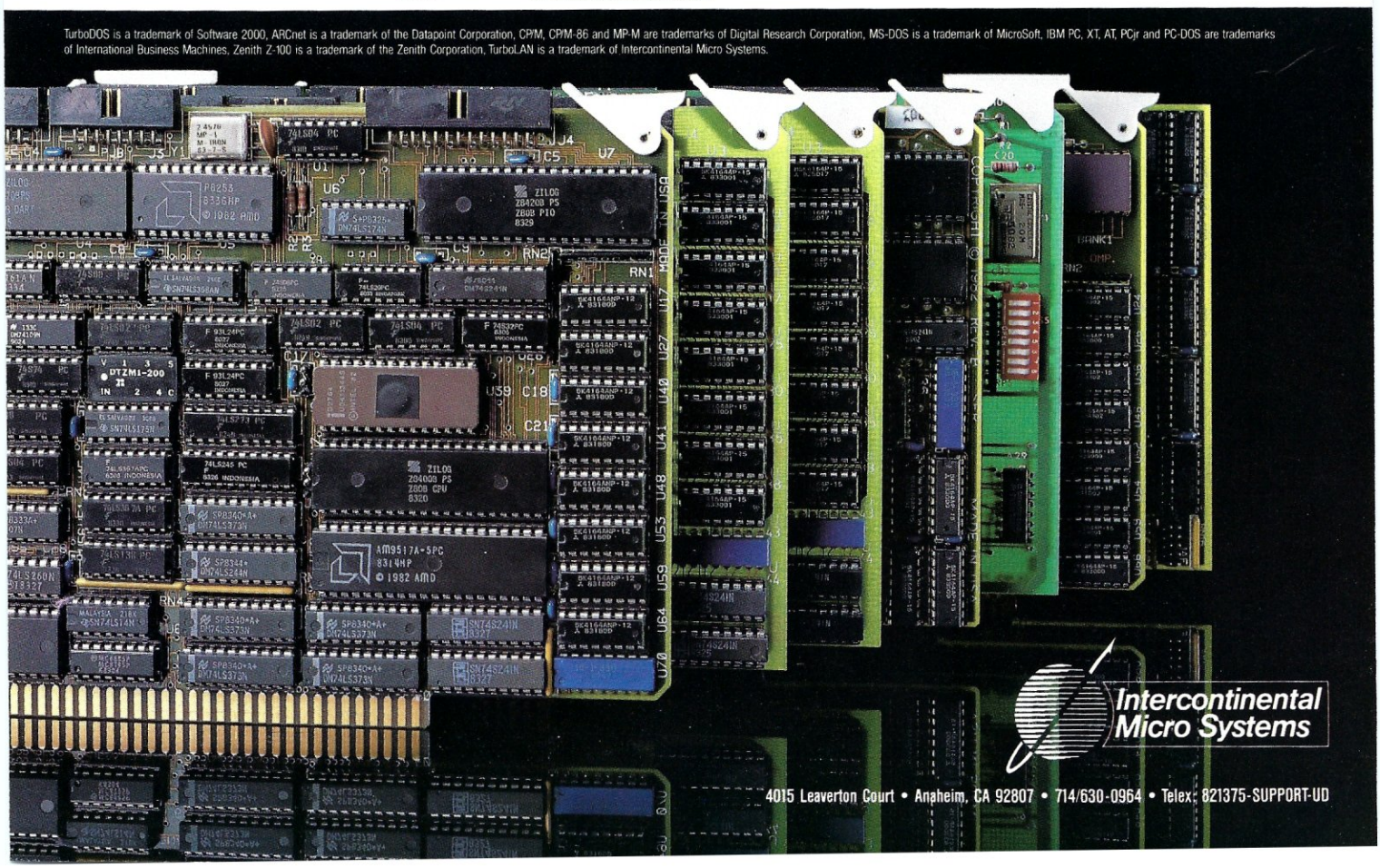

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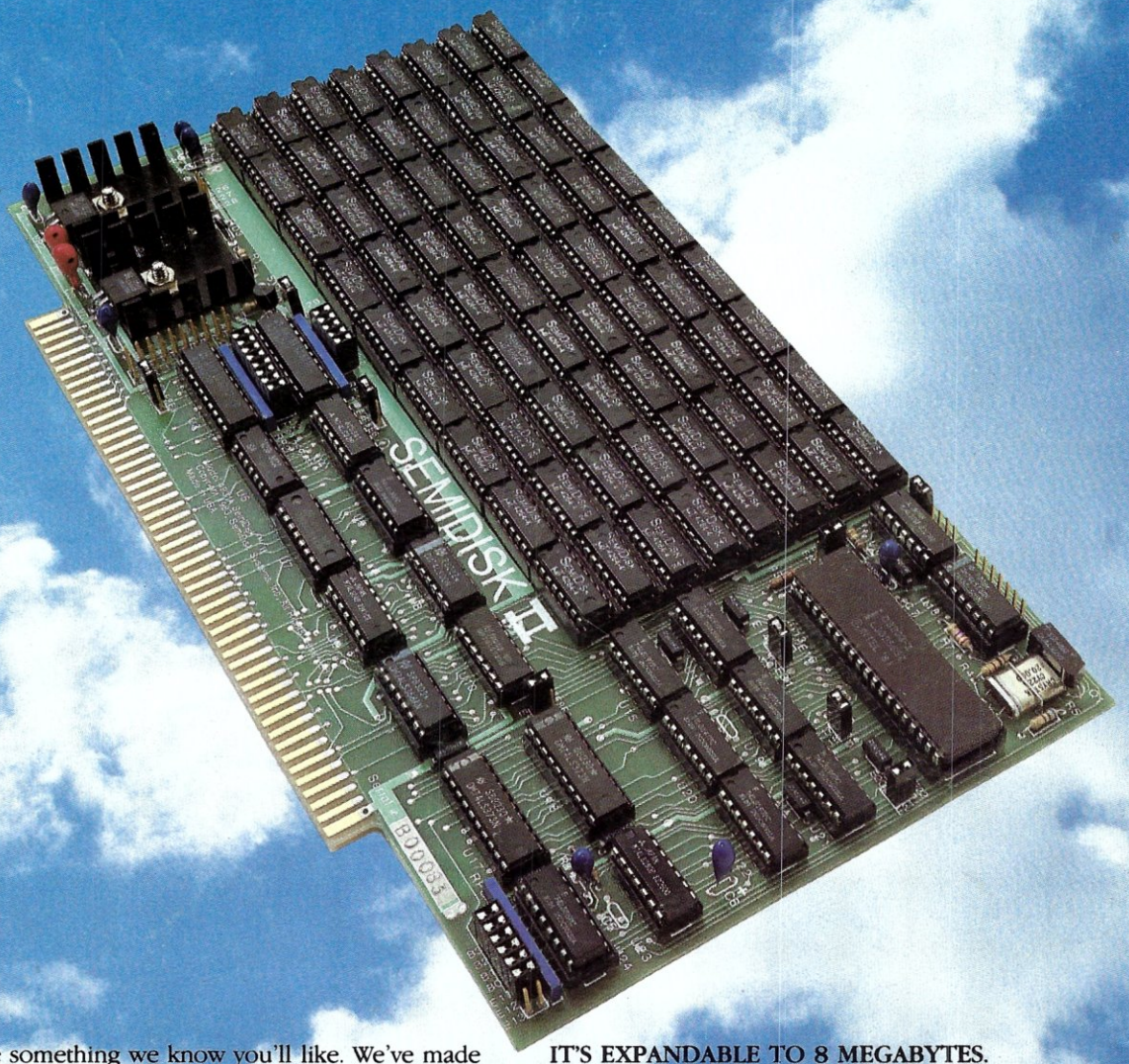

We've just done something we know you'll like. We've made the SemiDisk far more affordable than ever before. With price cuts over 25% for most of our product line. Even our new 2 megabyte units are included.

COMPARE WITH THE OTHERS.

SemiDisk Systems builds fast disk emulators for more microcomputers than anyone else. S-100, IBM-PC, Epson QX-10, TRS-80 Models II, 12, and 16. Up to 2 megabytes per board, standard. Up to 8 megabytes per computer, using only four bus slots, max! Software drivers are available for CP/M 80, MS-DOS, ZDOS, TurboDOS, VALDOCS 2, and Cromix. SemiDisk turns good computers into great computers.

GREAT NEWS FOR IBM PC AT USERS.

New MS-DOS 3.0 software drives take full advantage of the 80286's expanded instruction set, moving data four times faster than can be done on PC or XT.

BATTERY BACKUP, TOO.

At 0.7 amps per 2 megabytes, SemiDisk consumes far less power than the competition. And you don't have to worry if the lights go out. The battery backup option gives you 5-10 hours of data protection during a blackout. Nobody else has this important feature. Why risk valuable data?

IT'S EXPANDABLE TO 8 MEGABYTES.

You can start with as little as 512K bytes, and later upgrade to 2 megabytes per board. At your own pace, as your needs expand.

In an IBM PC, XT, and AT you can have multiple drives on a single system. And the SemiDisk gives you mainframe performance on the top of your desk.

AND THE BEST NEWS IS SAVED FOR LAST:

	512K	1Mbyte	2Mbyte
SemiDisk I, S-100	$695	$1395	
SemiDisk II, S-100	$995		$1995
IBM PC, XT, AT	$695		$1795
QX-10	$595		$1795
TRS-80 II, 12, 16	$695		$1795
Battery Backup Unit	$150	$150	$150

SEMIDISK

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503-642-3100

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